The Journal of ELECTRICITY, POWER and GAS

DEVOTED TO THE CONVERSION, TRANSMISSION and DISTRIBUTION OF ENERGY

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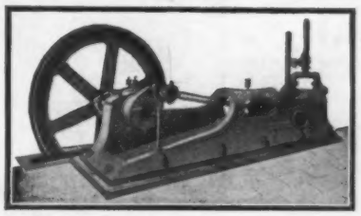

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INDEX TO CONTENTS PAGE V. CLASSIFIED LIST OF ADVERTISERS PAGE XXVII. ADVERTISERS INDEX PAGE IX.

373

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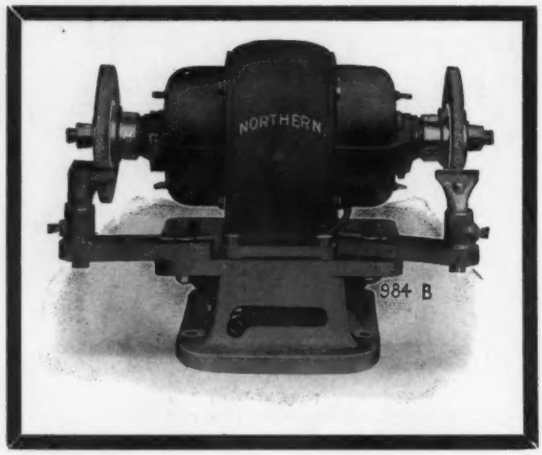

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Devoted to the Conversion, Transmission and Distribution of Energy.

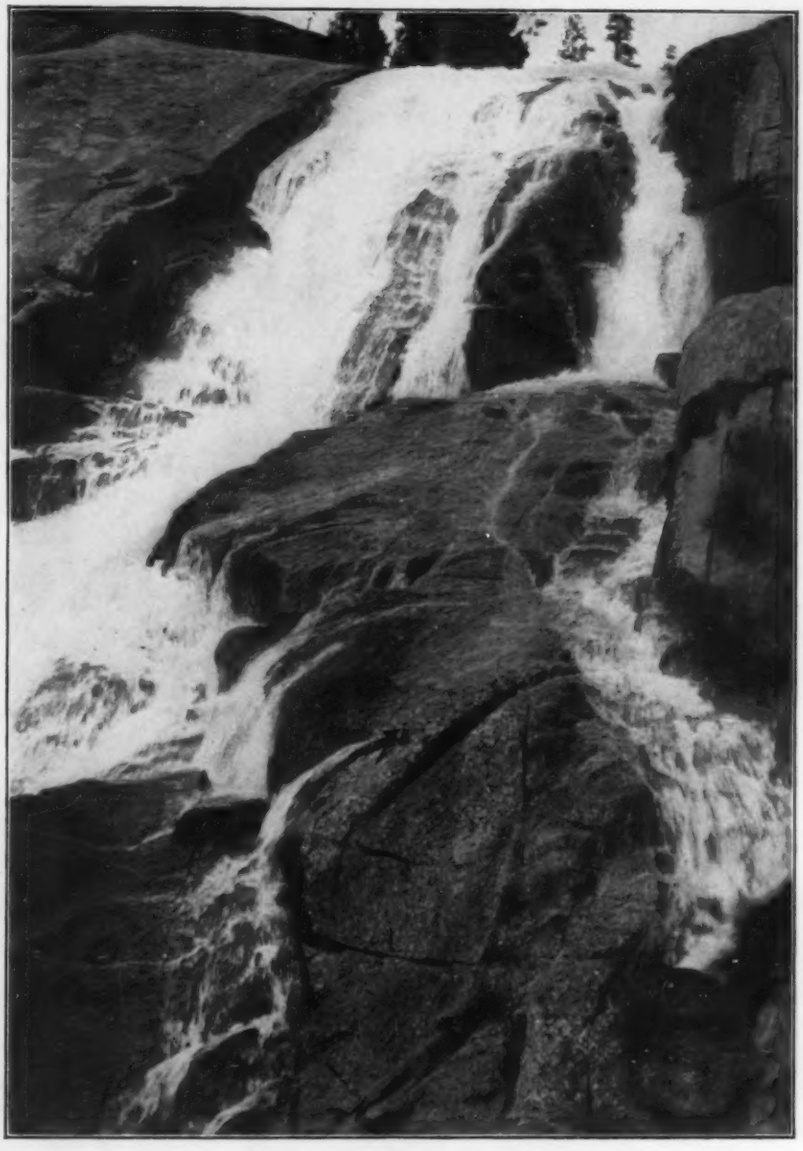
VOLUME XV. SAN FRANCISCO, CAL., FEBRUARY, 1904. NUMBER 2

The Hydro-Electric Power Plant of the North Mountain Power Co.

THE North Mountain Power Company, of San Francisco, has recently completed the principal arms of a modern hydro-electric power plant which is to serve Humboldt Bay and Eureka, in Humboldt County, this State. It is a twenty-five cycle installation, and is therefore primarily a power rather than a lighting plant. Power is the objective. Although there are lighting loads to carry, the frequency for such service is raised through motor-generator sets to the usual sixty cycles.

The field which this company has entered, not only in Humboldt but in Trinity County as well, promises to be a large consumer of power. The probabilities of rather extensive gold dredging operations on the Trinity River, near the power station, together with the diversified field already existent in Humboldt County, and which according to all precedents will greatly expand, presents substantial financial attractions. At the same time it is practically a virgin one, untrammeled by the usual sixty-cycle plants, save, perhaps, in two or three local lighting installations. It consequently imposed upon the engineer the necessity of choosing a frequency wholly adapted to motor loads. Lighting, within the sphere of the company's operations, which will at its maximum be small as compared to ultimate power loads. The cost of raising the periodicity from twenty-five to sixty, wherein only a small proportion of the total output goes into lighting, would clearly enough involve a less financial loss than that arising from a complete sixty-cycle installation with its inherently poorer characteristics and generally inferior power service.

The power station is located two miles north of Junction City, Trinity County, on the Trinity River, near the confluence of Canyon Creek. It is from the latter stream that the waters are diverted for the generating units. This creek has a basin of seventy-six square miles, the upper two-thirds of which serves as the catchment area above the diverting dam. The basin presents in a very striking manner the appearance of an immense amphitheater, the semi-circular walls of which stand up as a serrated escarpment of archean granite, 9000 to 10,000 feet above sea level. Within its limits snow falls in immense quantities and lies in certain localities throughout the entire year. Two lakes approximating seventy acres serve as impounding reservoirs and augment the low water run-off during August, September



THE FALLS OF CANYON CREEK

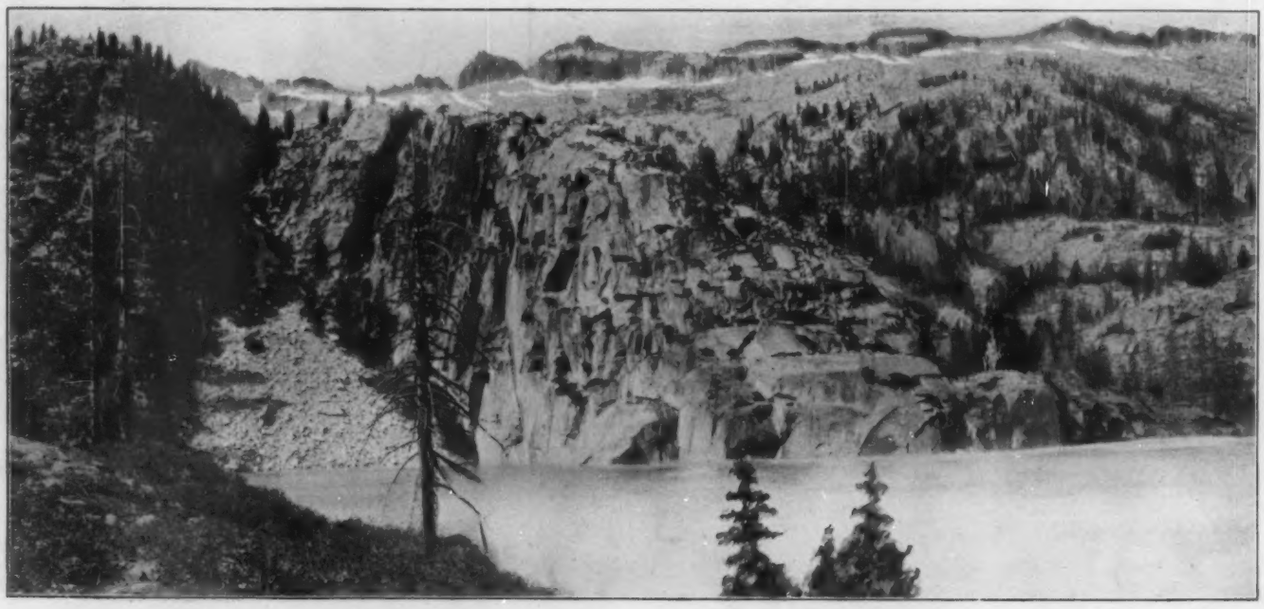
THE SOUTH FORK OF THE TRINITY RIVER

and October. The total run-off exceeds by many times the normal demand of the wheels. Of the many other water rights owned by this company, Canon Creek, from which this plant derives its power, alone can develop from 5,000 to 6,000 additional horsepower.

The dam is a small one, serving merely as a diverting structure, of the usual triangular open crib work design. It is twelve feet high and eighty feet long, and is reinforced by strong rectangular stone filled cribs at each end. Behind the west crib the water is taken out through three four-foot bays, the floor of which is eighteen inches below the dam crest. The flow is regulated by flash boards. A sand and overflow box is provided immediately below the crib where the flume proper begins.

The conduit is a composite one of alternating sections of wooden flume, side hill ditch and one section of tunnel. The respective sections conform generally to the typographical demands of the route. The entire length is 7.235 miles, of which 5280 feet are of wooden flume, 1670 feet of tunnel and the remainder is permanent side hill ditch. The flume is made up of thirteen sections, varying from 1200 feet, the longest, to thirty-four feet, the shortest. The gradient averages approximately 9.6 feet per mile, varying within small limits according to the cross-section of the channel. The average cross-section of the rectangular flume is five feet wide by three feet ten inches high. The ditch has a minimum width of five and one-half and a depth of four feet. The tunnel is four and five-tenths feet wide in the clear by six feet high, with a grade of 0.181 feet. The maximum capacity of the conduit is eighty-one second-feet. There are necessarily a number of waste gates and sand boxes, the latter, with one exception, being an enlarged and deepened sections in the ditch.

A series of three trash racks have been provided at the lower end, just outside the forebay. The forebay is fourteen feet wide, ten feet deep and sixty feet long, completely in solid rock. Three lines of penstocks, thirty feet apart, run directly to the wheels, a slope distance of 1160 feet, developing a total head of 604 feet. The effective head is 600 feet. Each pipe line is designed with a factor of four, and comprises, below the inlet



ONE OF THE MOUNTAIN LAKES OF TRINITY COUNTY WHICH SUPPLY WATER TO THE NORTH MOUNTAIN POWER COMPANY'S PLANT

A VIEW OF THE STORAGE RESERVOIR, TRINITY COUNTY

reducer, a line of thirty-six inch-, twenty-eight inch-, and, at the lower end, two lines of eighteen-inch riveted steel pipe. There are two complete lines of pipe now installed. The third line is, together with its corresponding unit, to be installed later. Each line is placed in a trench sufficiently deep to give two feet of back filling over the pipe. The back filling is well water tamped, and with the masonry and steel anchorages assit in giving a rigidly protected line.

Each hydraulic unit consists of a pair of forty-four-inch Pelton type special disc wheels under one sheet steel housing, pressed on a forged steel shaft. It is built to develop a maximum of 1650 horsepower, is carried in Pelton generator type ring oiling bearings, self-contained, and connected to the generator by means of a flexible leather link coupling. A fool-proof eighteen-inch outside screw and yoke bronze mounted and geared gate valve sets behind each nozzle. The nozzles are advisedly of the deflecting ball and socket type. If at times partial loads are demanded, one of the nozzles can be shut off. The wheels turn at 500 revolutions per minute. Each unit sets over a common tail race, and is protected from the spouting of the rear units by steel baffle plates bolted at one end to the water wheel bed-plate and at the other to I-beams embedded in the concrete walls of the race-way.

A BIT OF THE FLUME DURING CONSTRUCTION

The nozzles of each unit are controlled by a Lombard governor of the oil pressure piston type, having a separate oil pump driven by belting from the wheel shaft. Each governor has its independent oil tank.

The electrical apparatus now installed consists of two 750-kilowatt, 500 revolutions per minute, two-bearing, direct-connected, twenty-five-cycle, three-phase, Bullock generators, generating at 2200 volts. The generators are of the revolving field type, with six poles. The armature is stationary and bears the high voltage winding. Two forty-five-kilowatt, 900 revolutions per minute, 120-volt, compound-wound Bullock exciters are belt-driven from the generator shafts. Each exciter has sufficient capacity for the fields of both generators, and is so connected that either may be thrown into commission.

Two banks of three transformers each, with one spare, are installed in an adjoining fire-proof building. A track throughout the latter is provided with a car, the platform of which runs level with the bottom of the transformers for their handy removal. The step-up transformers have a capacity of 300 kilowatts at 100 per cent. power factor,

A BIT OF THE FLUME ON CONNOR CREEK, TRINITY COUNTY

twenty-five cycles, with a primary voltage of 2200 and a secondary of 33,000 when connected in Y. They are of the Bullock water-cooled, oil-filled type, furnished through the Wagner-Bullock Electric Company of California. The cooling water is drawn under low pressure from a nearby steel service tank fed from a cross-connection in the pipe lines. Provision has been made for the discharge of oil in case of fire. The two banks of high tension switches, with the lightning arresters, are installed in another adjacent building.

In the power house a special bay has been provided for the switchboard. The panels are of blue Vermont marble. There are two generator, one double exciter, and two transformer panels, provided with all the necessary instruments, circuit breakers, oil-break switches, rheostats, transformers, etc., including a swinging bracket at each end of the board, one carrying a synchronizer indicator and the other carrying a polyphase indicating wattmeter, practically all of which are of Bullock manufacture.

The powerhouse is built of concrete with steel trusses and corrugated roofing, and is provided with a ten-ton traveling crane. cement floor and underground conduits. The tail-race is six and one-half feet wide in the solid rock, a pseudo-slate formation, and passes out into the Trinity River, 300 feet distant.

The pole line is practically seventy miles long from the power house to the substation in Eureka. Although the line for nine-tenths of its distance passes over some of the most rugged country in California, it departs at no point more than two and one-half miles from a straight line drawn between terminii. It crosses four mountain ranges and three large rivers, 80 per cent. of its length being through heavily timbered country, necessitating an immense amount of clearing. The right-of-way from end to end, with the exception two-thirds of a mile through the heavy redwoods, was cleared of all trees. The clearing of this right-of-way fifty-six miles long and from 100 feet to 400 feet wide, including over thirty-five miles of trail, was accomplished in four and one-half months. Most of the trees ran from two feet to four feet in diameter, and generally were bull pine, white pine and red fir, with some oak and manzanita.

Hardly any of the route was on flat land, but on the contrary was usually upon hillsides with slopes as high as 38 degrees.

An idea of the ruggedness of the country may be gathered from the fact that the total rise and fall measured vertically, not including minor gulches, aggregates 44,900 feet (eight and one-half miles), equivalent to a climb from sea level to the top of the highest peaks in the Andes and back again.

The line is a single circuit, three-wire line with an average of thirty-five poles to the mile. The cross-arms are four inches by five inches and the spread is forty inches. Locke's two-piece porcelain insulators, each eight and one half inches in diameter, are used, these being mounted on sun-dried eucalyptus oiled pins of one and one-half inches diameter. The telephone circuit is of No. 10 B. B. galvanized wire, transposed every five poles. A third of a turn is made in the power wires every mile.

The longest span on the line is 1500 feet. The wire is No. 3 copper strand on all spans under 500 feet. On the regular line medium hard drawn copper is used. Across the Eureka marsh, one and one-half miles, piles were driven 200 feet apart on which the power poles were mounted. The cut-off on the piles was made seven feet above the marsh surface and the poles seated with a six-foot splice, two three-fourths-inch bolts with special cast iron washers having cutting ribs being used on each splice.

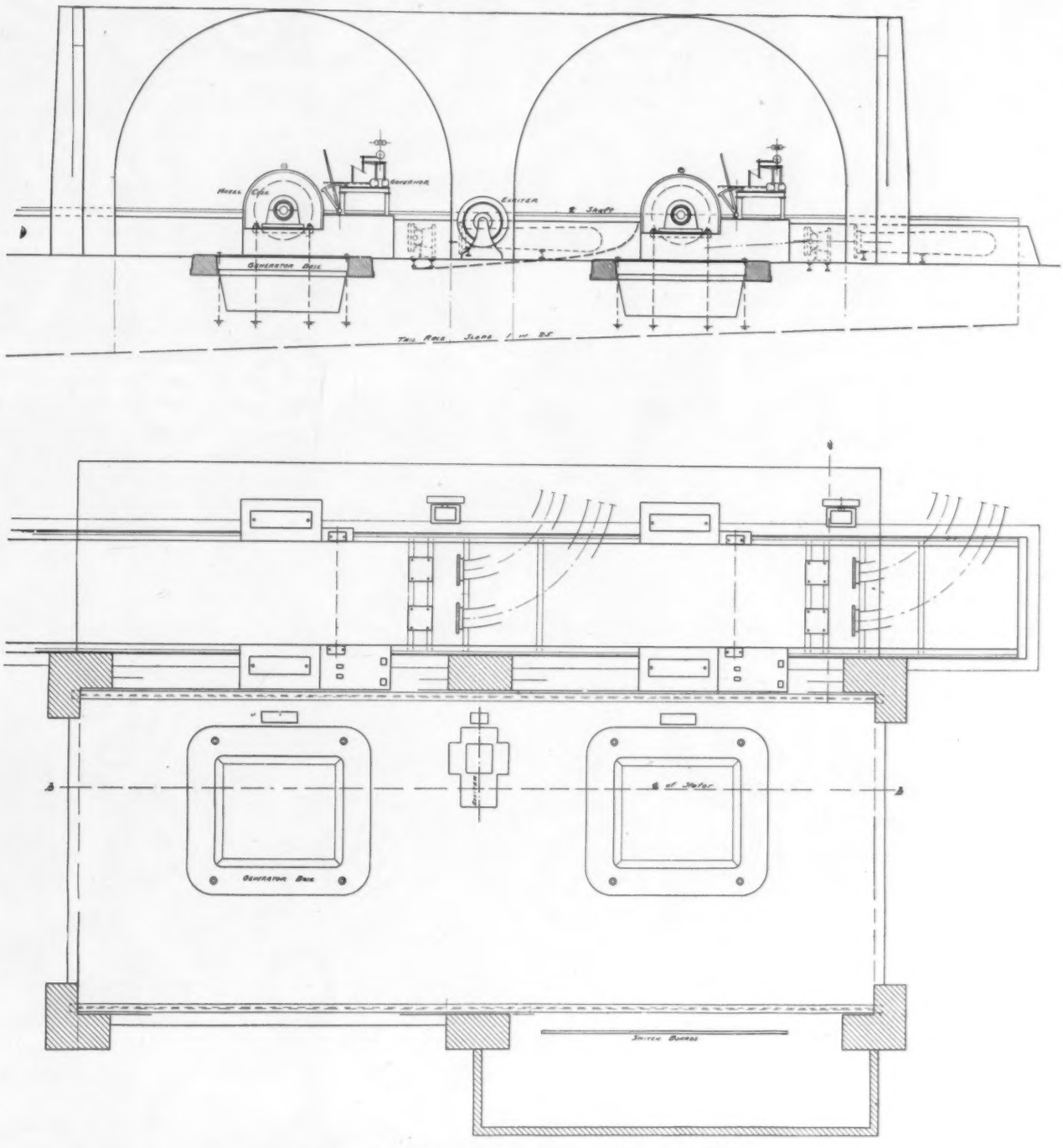
At the west end of the line for a distance of about ten miles first growth redwood poles were used. On the balance of the line the native red fir poles, the only possible material, was used. Imported cedar poles were absolutely out of the question. There was one stretch through the Trinity River canyon where the poles had to be "snaked" along a tortuous trail for three miles by mules working tandem.

The substation is a composite building of concrete and iron, 128 feet by 30 feet. It stands in the marsh on the water front, in the northeast corner of Eureka.

CHARACTERISTIC VIEWS OF THE WATER-WAY OF THE NORTH MOUNTAIN POWER COMPANY IN TRINITY COUNTY

Unbarked first-growth, redwood piles were driven under the entire structure. Upon the piles massive concrete construction was used up to the floor level, well above high tide. All piles were cut-off six inches below marsh level, and where continuous concrete walls were not necessary, battered concrete pillars were carried up to sills which were set upon corbels resting on the pillars. The pillars rest on a thirty-inch continuous footing course, the latter on top of a double row of piles, spaced about twenty inches between centres and five feet apart, staggered, in the direction of the building. This construction gave a sightly appearance to the building, and effected a big saving in concrete.

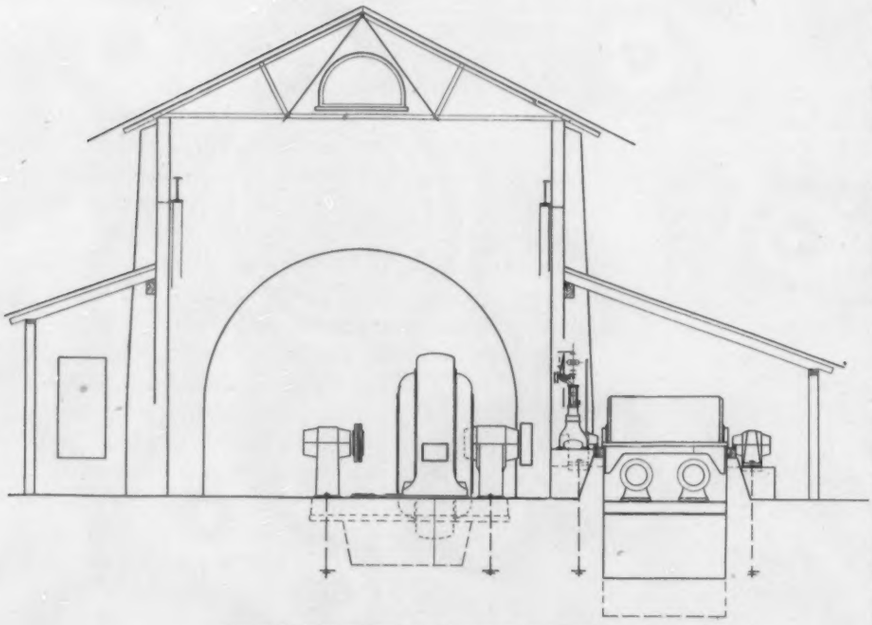
The auxiliary steam plant at Eureka consists of one horizontal, tandem compound, condensing, grid iron valve, McIntosh & Seymour engine, having a nominal capacity of 700 indicated horsepower, with a maximum



SIDE ELEVATION AND GROUND PLAN OF THE NORTH MOUNTAIN POWER HOUSE

capacity of over 1000 horsepower. The engine is connected with a jackshaft running at 500 revolutions per minute by means of rope drive on the American system, and this jackshaft is in turn connected to the rotary converter by means of a clutch coupling. An interesting feature of this plant consists in an arrangement enabling the clutch coupling to be thrown into service when running at the full speed of 500 revolutions. This is rendered possible by means of the electrically-operated speed changing device on the engine, giving control of the speed of the engine from the switchboard, together with the electric signal system which automatically indicates when both halves of the coupling are running at the same speed with jaws in position to intermesh without shock.

The engine is also fitted with McIntosh & Seymour time-delayed dash-pots, situated in the engine governor, which so control the speed of the engine as to make parallel operation possible with the water power transmission system. Being a tandem engine, this plant affords quite an interesting departure from the use of cross-compound engines of large size when parallel



END ELEVATION OF THE NORTH MOUNTAIN POWER HOUSE

operation is necessary, and is only rendered possible by means of the delayed dash-pots named.

In the west end of the building are located two Babcock & Wilcox water tube boilers having Peabody patent oil burning furnaces. Being a reserve steam plant, the boilers are furnished with furnaces specially adapted for heavy overloads. A duplicate fuel oil pumping system is furnished, together with duplicate feed pumps, Goubert auxiliary feed water heater and a concrete filtering hot well. Situated in the condenser pit formed by the L of the engine is a Wheeler "Admiralty" surface condenser, having a rectangular shell mounted over self-contained steam-driven air and circulating pumps. The steam installation is very complete and is thoroughly up to date. It was furnished by Chas. C. Moore & Co., Engineers, Inc., San Francisco, in the brief space of eighty days.

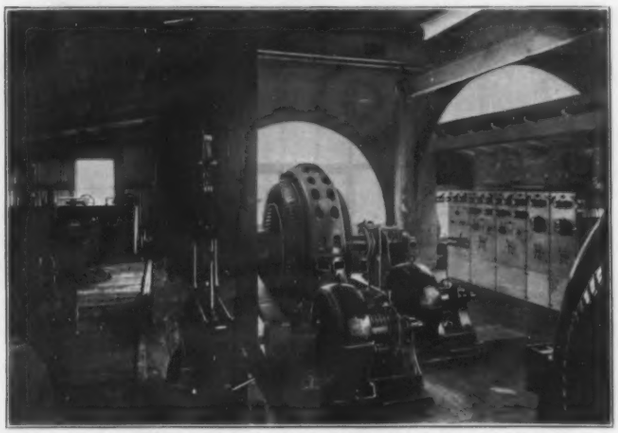
A fuel oil tank of steel fifty-four feet in diameter by twenty-five feet high with a capacity of 10,000 barrels, has been erected on property adjacant to the substation. It is connected to a nearby dock by a line of pipe.

In the substation end the high tension wires enter the switch room located in the east side of the building. Plate glass construction is used here. In the switch room, which is an absolutely fireproof compartment eleven by fourteen feet, of solid concrete, are located three banks of General Electric lightning arresters and one General Electric 40,000-volt motor-control oil switch of the isolated break type.

The high tension wires on leaving the switch room pass directly down through eight-inch glazed tile to lowering transformers located directly below in a fireproof concrete compartment fifteen by thirty feet in size, with fifteen feet of head room. In this compartment are located three 400-kilowatt General Electric, water cooled type, step down transformers, lowering from 30,000 to 2300 volts, and three 190-kilowatt Bullock water-cooled transformers, stepping down from 30,000 to 352 volts for the rotary converter.

The low tension wires leave the transformer room in a cable trench and rise from below to a seven panel switch-

THE GENERATING STATION, AND TRANSFORMER AND SWITCHING HOUSES, RESPECTIVELY, OF THE NORTH MOUNTAIN POWER COMPANY



AN INTERIOR VIEW OF THE NORTH MOUNTAIN POWER HOUSE

ammeter, one alternating current ammeter, one alternating current voltmeter and one three-pole, double-throw switch for operating the electrical control regulator on the engine governor.

On the direct current panel is mounted a large single-pole disconnecting switch, one direct current wattmeter, one rheostat mounting, one single-pole lighting switch, two double-pole field break switches, and one automatic circuit breaker. On a swinging bracket to the right of the panel a 750-volt, direct current voltmeter and synchronizing indicator are mounted.

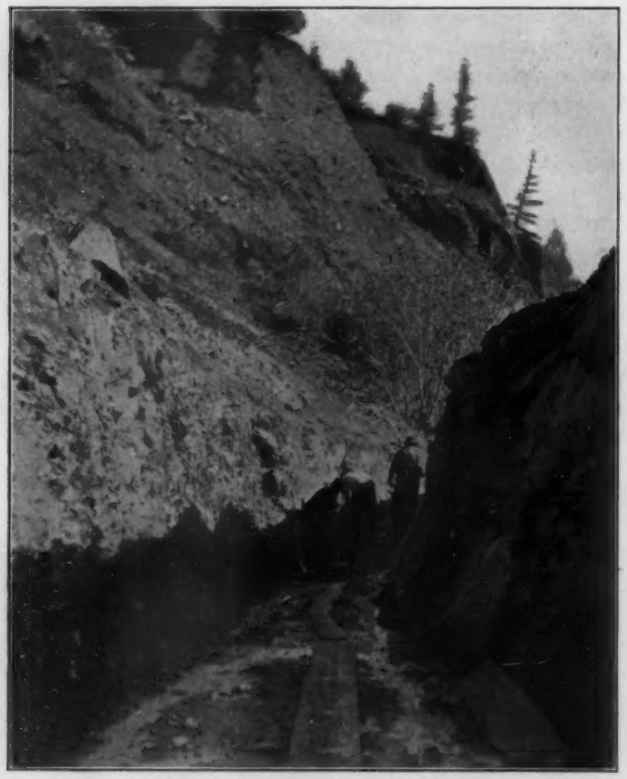
The rotary converter is located directly in front of the switchboard and is a six-pole, twenty-five-cycle, 500-kilowatt machine of Bullock make. It is considerably larger than the present railway load requires, but in

THE FIRST THREE VIEWS ILLUSTRATE SOME FEATURES OF MOUNTAIN TEAMING; THE LAST SHOWS THE POWER HOUSE

board. The main transformer panel is located on the extreme left. To the right of this panel are four three-phase feeder panels and two rotary converter panels. On the main transformer panel are mounted a 400-ampere, 2300-volt, time limit, automatic oil switch, a polyphase Thomson recording wattmeter, one voltmeter plug and receptacle, three 400-ampere ammeters, and on a swinging bracket is mounted a 175-volt voltmeter. The feeder panels each contain a 300-ampere, three-phase, automatic oil switch, and three 175-ampere ammeters.

On the alternating current panel of the rotary converter is mounted a large three-pole disconnecting switch, one three-pole motor-starting switch, one regulating control lever for starting the motor, one voltmeter plug and receptacle, one synchronizing plug, one direct current

POLE RAISING ON THE RIGHT-OF-WAY THROUGH THE FOREST



THE TAIL RACE FROM THE POWER HOUSE

order to guarantee continuous service on both alternating and direct current loads, the tandem compound engine was installed and connected with a rope drive to a jack shaft, located at collector ring end of the rotary. The collector ring end of the rotary shaft is extended, and one-half of a square jaw clutch is mounted thereon. The movable half of the clutch is mounted on the end of the jack shaft with suitable levers for operating the clutch. There is also a synchronizing device mounted on the clutch so as to enable the operator to synchronize, clutch-in the engine, and to take the rotary off the line with the engine, thereby enabling the line to be shut down at periods of light loads for repairs, which can be made without interrupting the service on either the direct or the alternating current circuits.

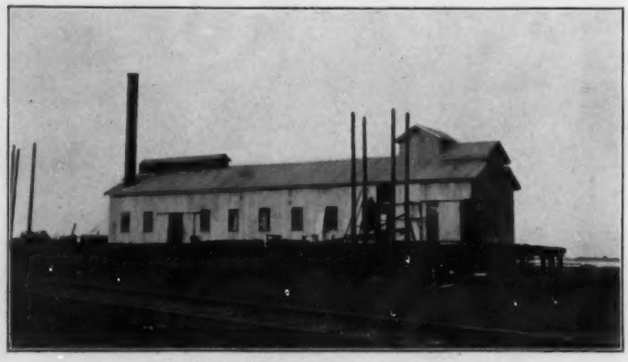
Although about seven-tenths of the ditch at the power house had been constructed and previously used by an old hydrulic mining company, it had to be wholly revamped, which, including new work, extensions, renewals, repairs and new tunnel work, required nearly six months. This was completed, together with the entire plant, save some minor detail work of installation and drying out of transformers, in a remarkably short period. Active construction was begun on July 1st and the water was turned into the penstock at 4 p. m. on January 1st. The pole line clearing was begun on July 20th, and the copper connected up on December 28th, excepting over a strip of two miles near Eureka where right-of-way privileges could not be secured from an irascible owner until the eleventh hour.

HOW WIRE IS PACKED TO THE POLE LINE

Work on the substation and auxiliary steam plant was begun on August 20th. Steam was turned into the engine December 31st, and the whole plant was therefore substantially completed in six months.

The power house is located sixty miles by way of a very rough mountain wagon road from the railway. This work and the pole line was consequently remote from labor markets, and many of the workmen were ever ready to take advantage of such seemingly insuperable conditions.

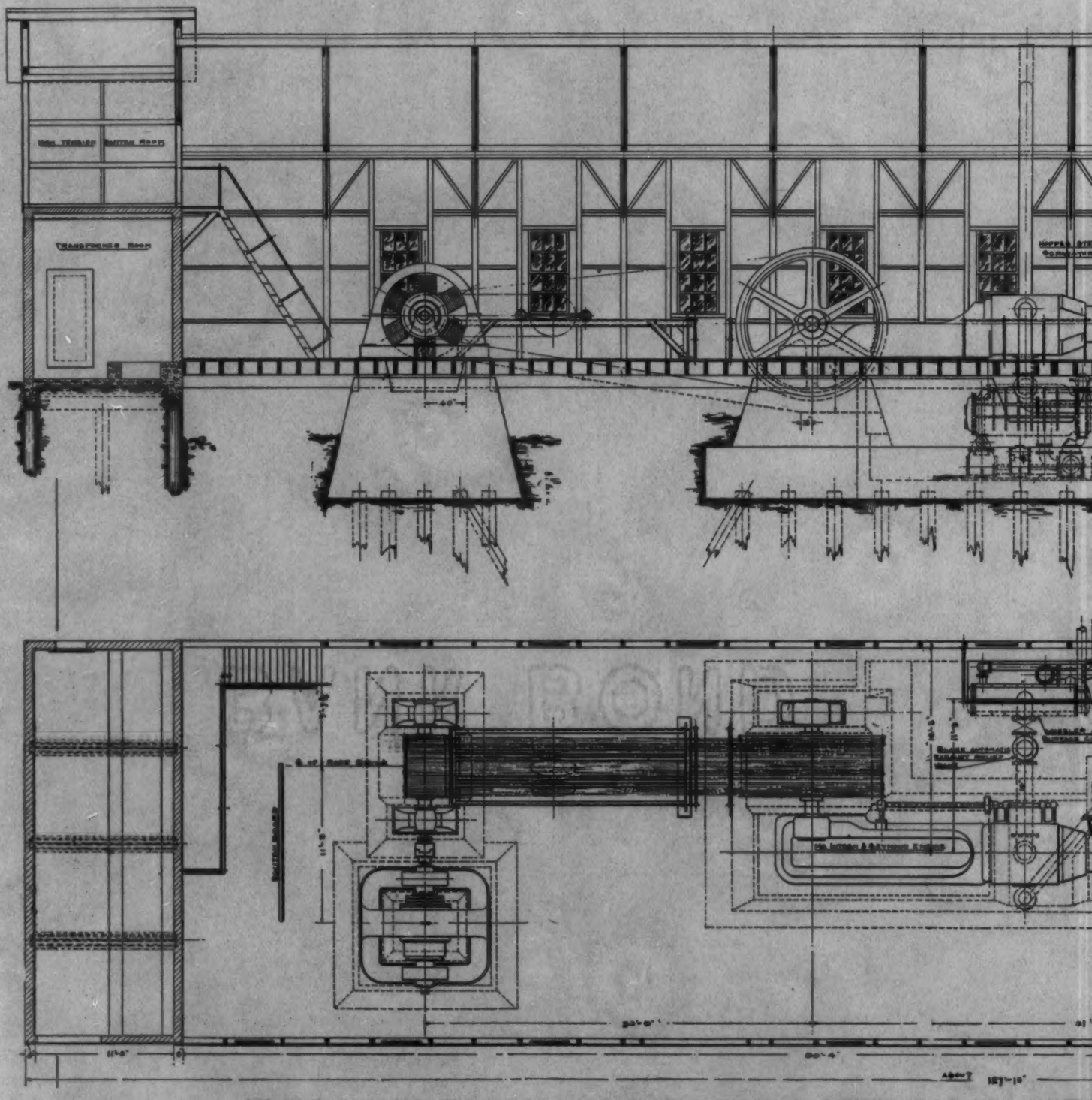
The executive offices of the North Mountain Power Company are located at 18 California Street, San Francisco, while the power or operating office is at Eureka. Jno. M. Vance, the well known banker of Eureka, is president of the corporation; F. J. Koster, of San Francisco, is vice-president; George T. Ruddock, of San Francisco, is second vice-president, and R. J. Tyson, also of San Francisco, is secretary. J. C. Ralston, of Spokane, Wash., is chief engineer for the company, and J. B. Rogers, of San Francisco, is assistant engineer in charge at the power house during its construction, and similarly H. L. Jackman, who becomes general superintendent of the company upon the completion of the plant, was assistant engineer in charge at Eureka during construction.



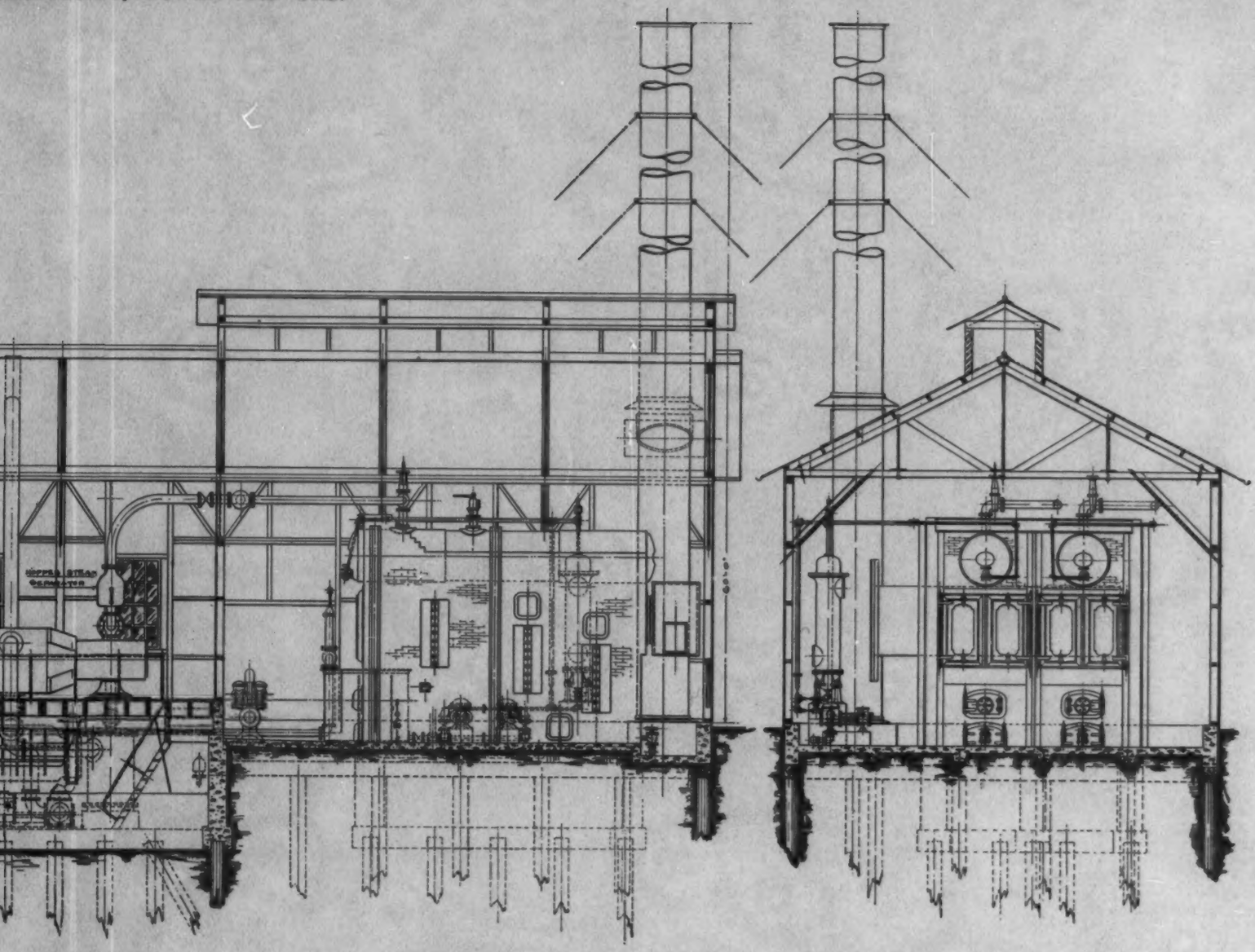
THE EUREKA STEAM AUXILIARY SUBSTATION

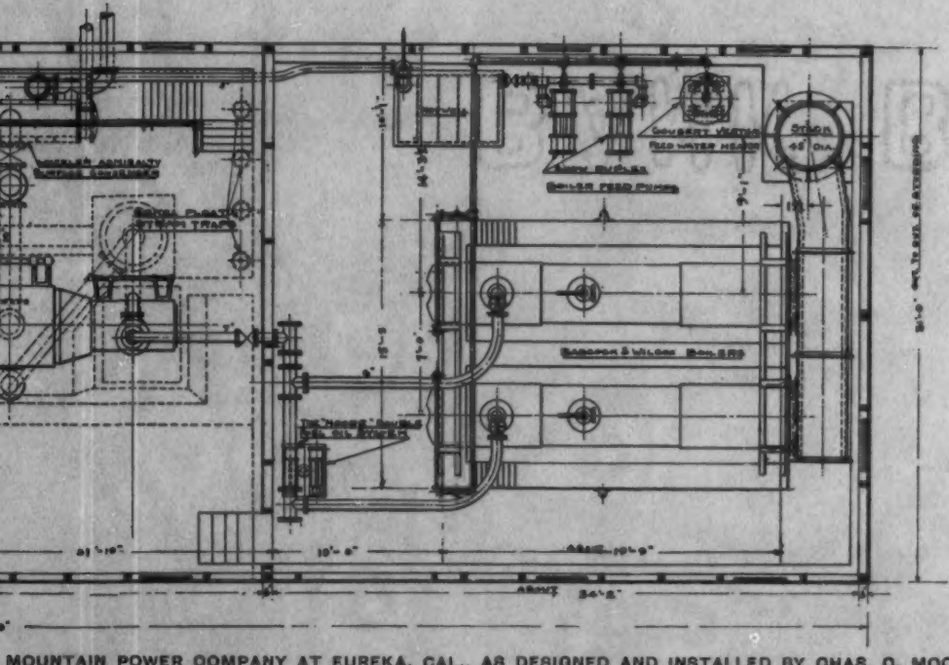
The plant briefly described in the preceding paragraphs is the nucleus of that which will ultimately be a large installation.

Mr. George H. Rowe, late professor of electrical engineering at the Leland Stanford Junior University, has moved to Boulder, Colorado, where he is to engage in consulting electrical engineering. The serial on "Alternating Laboratory Testing," bearing his authorship and which is being run in THE JOURNAL, will, of course, be continued uninterruptedly.



GROUND PLAN AND END AND SIDE ELEVATIONS OF THE STEAM AUXILIARY SUBSTATION OF THE NORTH MOUNTAI





MOUNTAIN POWER COMPANY AT EUREKA, CAL., AS DESIGNED AND INSTALLED BY CHAS. C. MOORE & CO. (INC.), ENGINEERS

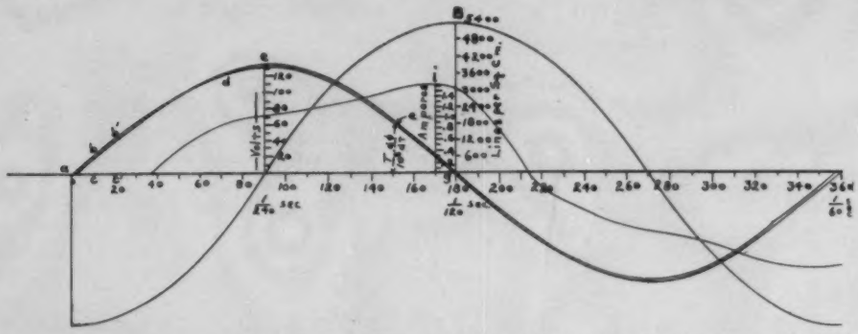
ALTERNATING CURRENT LABORATORY TESTING.

BY GEORGE H. ROWE.

PART I—CONTINUED.

TO DRAW THE CURVE OF INSTANTANEOUS FLUX FROM THE CURVES OF CURRENT AND ELECTROMOTIVE FORCE.

Multiply the instantaneous values of current in Figure 8 by the ohmic resistance R, and subtract the products from corresponding ordinates of curve e, plotting as in Figure 9.



Curves of instantaneous electromotive force, current and induction B, showing method of deriving the curve of B by planimeter from Figure 8:

$R = .042$ ohm.

$$e = iR + \frac{T}{10^8} \cdot \frac{d\phi}{dt}$$

FIFURE 9

The ordinates of the resulting curve are the instantaneous values of the electromotive forces which overcome the counter electromotive forces $= \frac{T d\phi}{10^8 dt}$

At any instant of time the tangent* to the curve of flux multiplied by $\frac{T}{10^8}$ will give the electromotive force to overcome at the same instant. Conversely, the integral of the electromotive force curve divided by $\frac{T}{10^8}$ will give the curve of flux. It will be seen that when the electromotive force, $\frac{Td\phi}{10^8 dt} = o$, ϕ should be a maximum, and when $\frac{Td\phi}{10^8 dt}$ = maximum, $\phi = o$.

Also, since as many lines of flux must pass into the coil as pass out, the curve of flux ϕ must cut the axis of X immediately under the cenrer of gravity of the $\frac{Td\phi}{10^8 dt}$ curve. Therefore determine by means of a planimeter the area between the $\frac{Td\phi}{10^8 dt}$ curve, the axis of X and the ordinates passing through the center of gravity. This area divided by $\frac{T}{10^8}$ is proportional to the maximum flux Φ. Plot this area as a line of maximum flux downward from a, Figure 9. Find the small area abc, and subtract from the initial ordinate for a new point of the curve of flux, etc. By drawing to scale, the absolute values in magnetic lines may be obtained. Or since $B = \frac{\phi}{A}$=flux density, where A is the area of cross section of the iron core, we may plot flux density as in the figure.

*See Jackson's Alternating Currents, page 284.

To draw the core loss area from the curves of e, i and B:

The instantaneous magneto-motive force is $\frac{4\pi Ti}{10\, l} = H$ where T is the number of turns, i the instantaneous current in amperes, and l the mean length of magnetic circuit in centimeters. Therefore from Figure 9 may be plotted the closed area represented in Figure 10.

The lack of symmetry of the two sides of the half wave of current is seen to be due to a variation of the relation between i and B, or, in other words, to the effect of hysteresis and eddy currents. The true magnetization curve for the sample of iron under test may be plotted as curve a, Figure 10.

The current curve in Figure 9 can now be resolved into two components, one* the magnetizing current in phase with the flux and plotted at i mag. in Figure 11, and the other a current at right angles to the magnetizing current, and therefore an energy component to overcome iron losses. If the permeability can be assumed constant the magnetization curve becomes the straight line b, Figure 10, and i mag., Figure 11, becomes a sine curve.

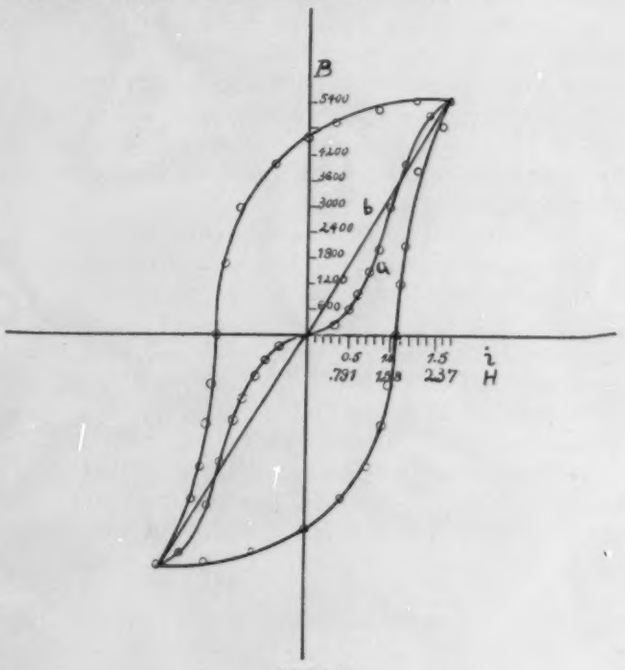


FIGURE 10

The instantaneous power in the circuit is

$$ei = Ri^2 + \frac{Td\phi i}{10^8 dt},$$

$$\text{or } ei = Ri^2 dt + \frac{Td\phi i}{10^8 dt} dt$$

*Elements, page 51.

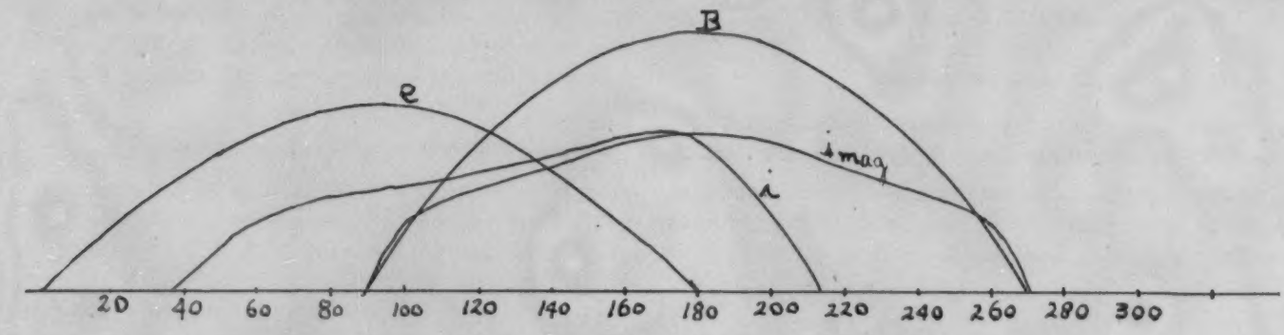


FIGURE 11

But $Ti = \frac{10\,H\,l}{4\,\pi}$

and $\phi = A\,B$

and $d\,\phi = A\,d\,B$

Hence the total energy wasted during one cycle of T seconds will be

$$\int_0^T e\,i\,dt = \int_0^T R\,i^2\,dt + \frac{A\,l}{10^7\,4\,\pi}\int_{-B\,\max.}^{+B\,\max.} H\,dB \quad \text{joules.}$$

The integral is the iron loss area represented in Figure 10. The area of the curve multiplied by the proper scale of B and H and by $\frac{A\,l}{10^7\,4\,\pi}$ expresses the energy per cycle in joules. Multiplied by the frequency $\sim$, the result should equal the wattmeter reading minus the $R\,I^2$ or copper loss. The iron loss area evidently contains both hysteresis and eddy losses.

The negative areas represented in the power curve of Figure 8, indicate that a part of the energy is returned to the circuit. Had hysteresis and eddy losses been absent, the differences between the positive and negative areas for one cycle would have been equal to the copper loss, $i^2\,R$, all energy stored in the field during a part of the cycle being returned to the circuit during the remaining part of the cycle.

From the above experimental determination of currents and electromotive forces, it is seen that if the resistance is negligible, the electromotive force to overcome self-induction is in phase with the impressed electromotive force, and the current can be resolved into energy and wattless components. If the resistance is not negligible, the current can be resolved into two components in phase and quadrature with the impressed electromotive force e. The resistance loss may therefore be considered as increased by hysteresis and eddy loss. Call R^1 the value of this "effective resistance." Then $R^1\,i^2$ = energy component of current $\times$ e, or $R^1\,i^2$ = total current i $\times$ energy component of electromotive force.

Hence $R^1 = \frac{\text{energy component of electromotive force}}{\text{total current.}}$*

Similarly considering the magnetizing component only, we can define "effective reactance" by the following process of reasoning:

Assume $L = \frac{\phi\ \text{max.} \times \text{Turns}}{\text{Amp. max.} \times 10^8}$ by definition.

*Phenomena, page 104.

Then line b Figure 10, shows $\frac{\phi}{i}$ constant

For low destinies $\frac{\phi}{i}$ can be assumed constant.

$$\text{Hence } L = \frac{\phi \times T}{i \times 10^8}$$

$$\text{or } L\,i = \frac{\phi\,T}{10^8}$$

$$L\,\frac{di}{dt} = \frac{T\,d\,\phi}{10^8\,d\,t},$$

and instead of the equation

$$e = R\,i + \frac{T\,d\,\phi}{10^8\,d\,t}$$

we have the usual differential equation of electromotive forces,

$$e = R\,i + L\,\frac{di}{dt}$$

If, now, a sine law of variation of the impressed electromotive force e is assumed, we have $e = E$ max. $\sin\theta$, where θ is measured either in degrees or time from the position of zero electromotive force. If expressed in time, θ becomes $= \frac{2\,\pi\,t}{T}$, T being the time required to complete one cycle, in this case $\frac{1}{60}$ second, and t being the time in seconds after the zero of the wave. But the number of periods per second multiplied by the time required for one period must equal one second

$$\text{or } \sim \times\ T = 1$$

$$\text{or } \sim = \frac{1}{T}$$

$$\text{Hence } \theta = 2\,\pi \sim t$$

$2\,\pi \sim$ = angular velocity = ω

and we have E max. $\sin 2\,\pi \sim t = R\,i + L\,\frac{di}{dt}$

The solution of this equation is

$$i = \frac{E\ \text{max.}}{\sqrt{R^2 + \omega^2 L^2}} \sin(\omega t - a) + C$$

where a is the angle whose tangent is $\frac{L\,\omega}{R}$ and C is a constant of integration whose value may be shown to be equal to $\epsilon\ \frac{(t - t_1)}{L} \sin(\omega\,t - a)$.

The effect of this exponential term becomes negligible soon after closing or opening the circuit, but during a short interval its effect is far from negligible and gives rise to current rushes and pulsations of electromotive force. See oscillograms b and c, Figure 5.

These relations, with the exception of the exponential term, will be found plotted in Steinmetz Elements, page 30.

Neglecting the exponential term, we have

when $(\omega t - a) = o$

$$I \text{ max.} = \frac{E}{\sqrt{R^2 + L^2 \omega^2}}$$

or since I max. $= \sqrt{2}\, I$ virtual

$$\text{then } I \text{ virtual} = \frac{E \text{ virtual}}{\sqrt{R^2 + L^2 \omega^2}}$$

or $E^2 = \omega^2 L^2 I^2 + R^2 I^2$

ωL is defined as true reactance

$\omega L I$ is the electromotive force to overcome reactance and leads the current by 90 degrees.

Hence we may write $I = \frac{E}{r + j x}$, x being true reactance. If, now, hysteresis, eddy losses, etc., are present, the "effective reactance" can be defined as

$$x = \frac{\text{electromotive force in quadrature with current*}}{I}$$

Similarly the conductance g and susceptance b can be defined. These definitions furnish the basis of Steinmetz method of attacking alternating current problems.

CURVES OF ELECTROMOTIVE FORCE, CURRENT AND POWER IN A CIRCUIT CONTAINING RESISTANCE AND CAPACITY.

Connect the apparatus as in Figure 6, except that a condenser should be placed in the circuit at M. Condensers capable of withstanding 500 volts are obtainable. Several of these placed in multiple will give with 500 volts impressed pressure a charging current large enough

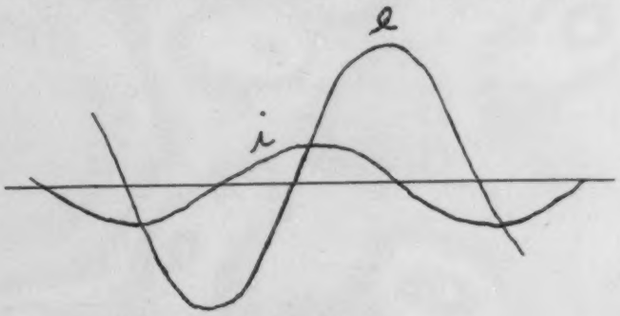


FIGURE 12

to be accurately measured. The curves will be similar to the oscillogram shown in Figure 12, the current leading the electromotive force.

The electromotive force at any instant overcomes the drop due to resistance and the counter electromotive force due to the presence of cepacity, or $e = i R + e_1$.

At any instant the current is i amperes.

During a time $d t$ this current will send a quantity $d q$ columbs into the condenser C.

$$d q = i\, d t.$$

and hence $Q = \int i\, d t$

*Steinmetz Phenomena, page 104.

But $Q = c\, e_1$ where C is the capacity in farads and e_1 is the electromotive force in volts.

$$\text{Hence } e_1 = \frac{1}{C}\int i\, d t$$

Subtract the products of $i R$ from the curve of e in Figure 12. The remaining curve is e_1. Multiply this curve by C to obtain the curve of charge or electrostatic flux q. From these a closed area with electrostatic flux q as ordinates and electromotive force e as abscissæ can be drawn as in Figure 13.

The area of this curve is $\int e\, d q$ joules per cycle. Multiplied by the frequency the loss in watts is obtained.

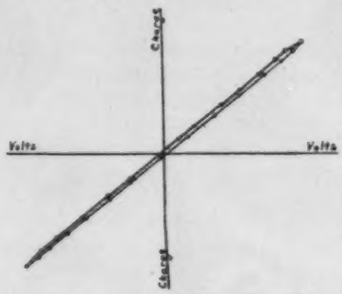


FIGURE 13. CURVE FOR DIELECTRIC HYSTERESIS

This "dielectric hysteresis" is extremely small, and the energy stored in the condenser during the first part of a cycle is almost completely returned to the circuit during the remainder of the cycle.

Assuming a sine wave of impressed electromotive force we have

$$C = E \text{ max. } \sin \omega t = R i + \frac{1}{C}\int i\, d t$$

which reduces to

$$i = \frac{E \text{ max.}}{\sqrt{R^2 + \frac{1}{C^2 \omega^2}}} \sin (\omega t + a) + C^1$$

$$\text{where } a = \tan^{-1} \frac{1}{C R \omega}$$

when $(\omega t + a) = o$

$$\text{then } I = \frac{E}{\sqrt{R^2 + \frac{1}{C^2 \omega^2}}}$$

or symbolically in rectangular co-ordinates

$$I = \frac{E}{R - j \frac{1}{\omega C}} = \frac{E}{R - j x^1}$$

$-j I x^1$ is the electromotive force to overcome capacity reactance and is 90 degrees *behind* the current.

If, now, dielectric hysteresis, leakage or brush discharge or corona loss be present, we can define x^1 to be $x^1 = \frac{\text{electromotive force in quadrature with current}}{I}$, and if resistance, inductance and capacity are present, then $I = \frac{E}{r + j (x - x^1)}$ and $(x - x^1)$ is the effective reactance, including the effect of all losses. The effective resistance, etc., are similarly defined.

The symbolic expression $I = \frac{E}{r + j (x - x^1)}$ is based on the usual clock diagram representation of the vector. In polar co-ordinates the expression becomes

$$I = \frac{E}{r - j (x + x^1)}$$

Figure 14 shows an oscillogram of current and electromotive force taken at the generating station of a high

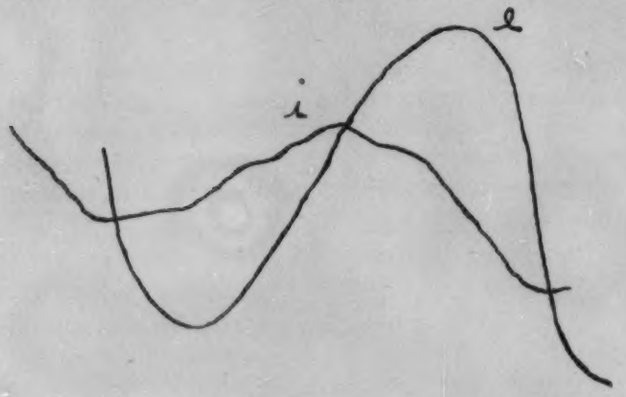


FIGURE 14

voltage transmission system. The negative reactance x^1 being in excess of the positive reactance x, the current leads the electromotive force.

(Continuation in next issue.)

THE FIRST 40,000-VOLT POWER TRANSMISSION IN EUROPE.

BY EMILE GUARINI.

THE three-phase 40,000-volt power transmission from Gromo to Nembro (Lombardia) is believed to be the first of this kind in Europe. The problem which had to be solved by the engineers in this plant was as follows: Two-thousand horsepower available at Gromo must be converted into electrical energy and transmitted by means of one or two three-phase overhead lines to Nembro, a small town some thirty-five kilometers distant, where the spinning mills of Messrs. Crespi & Co. were to be driven. The power must be taken from the Serio, a swift flowing mountain stream taking its origin in the Alps north of the industrial town of Bergamo, in Lombardia, and flowing through the picturesque Seriana Valley. The Serio was found to be capable of developing 4000 horsepower; 2000 at Gromo and 2000 at a point higher up the stream. At present the river has only been utilized at Gromo. At first one line only will be erected, although the possibility exists that a second one will be laid for carrying the energy to a greater distance. Provision must therefore be made for ultimately fixing this second line on the same poles as are used for the first. Assuming that all the available energy will be utilized, the loss in the line must be a minimum, although it is equally essential that the prime cost of the installation be kept low. As regards the plant itself, the whole must be carried out in a clear and simple manner, so as not to complicate manipulation or endanger the safe working of the system. These were the conditions to be fulfilled. The carrying out of this scheme was intrusted to the Brown-Boveri Company. How they acquitted themselves of their task, and the reasons which prompted them to adopt an extra high working pressure for a medium sized power transmission for a comparatively small distance remain to be explained. The preliminary tender submitted to the client was worked out on the following basis: Two-thousand horsepower to be transmitted by three-phase currents at a pressure of 30,000 volts. The line to consist of three bare copper wires of six and five tenths millimeters diameter each, giving a drop approximating 4 per cent. The above data really represent the ideal conditions for this particular installation, and it would have been impossible to obtain as satisfactory results with a lower working pressure. As regards the additional 2000 horsepower which would have been utilized at a future date, this would have been transmitted by a similar line on the same set of poles.

However, several difficulties cropped up which would have rendered the above scheme impractical. The creation of a second line without interrupting the service of the first would, in this particular case, have presented great difficulties. Moreover, although at first glance one feels inclined to consider a double transmission line advisable so as to guard against breakdowns, this advantage does not exist in practice when the two lines are mounted on one and the same set of poles. As two sets of poles were excluded on account of the prohibitive monetary outlay which this course would have entailed, the only remaining solution was to design the line from the very commencement for a 4000 horsepower transmission. In order to keep down the drop in the line to from 4 to 5 per cent. with this increased output, either the sectional area of the copper conductors would have to be enlarged, or the line voltage raised. Both solutions result in an increase in the capital outlay. Augmenting the sectional area meant a proportionally high increase in the copper, and therefore the cost of the line, while the alternative necessitated more costly insulating material. The cost of the first plan, however, far outweighed that of the second, so that the latter course was favorably considered. Moreover, raising the line pressure to 30,000 volts had no serious drawbacks, as this latter pressure was quite as suitable and offered as much security for safe working as 20,000 volts, providing suitable apparatus was employed, so that, after having duly considered the pros and cons of each scheme, it was decided to abandon the original one and to adopt the second project—*i. e.*, to dimension the line from the very beginning to transmit 4000 horsepower at a pressure of 40,000 volts. The power plant was officially started in July of last year, and the results obtained were beyond expectation, the plant has also withstood the severe thunderstorms which rage during the hot summer months in the north of Italy. This installation is another witness to the truth of the economical working and reliability of high pressure plants which, thanks to the special devices employed, require no more attendance than is necessary for medium pressure plants. As regards danger to life, this factor has practically been reduced

SOME FEATURES OF THE GROMO POWER STATION

FIGURE 1. THE POWER HOUSE AND EMPLOYEES' RESIDENCE
FIGURE 2. ONE THOUSAND HORSEPOWER ALTERNATORS AND TURBINES
FIGURE 3. INTERIOR OF THE POWER STATION, SHOWING THE SWITCHBOARD GALLERY

FIGURES 4 TO 9. CHARACTERISTIC VIEWS OF THE GROMO-NEMBRO 40,000-VOLT TRANSMISSION LINE, SHOWING THE NEMBRO SUBSTATION

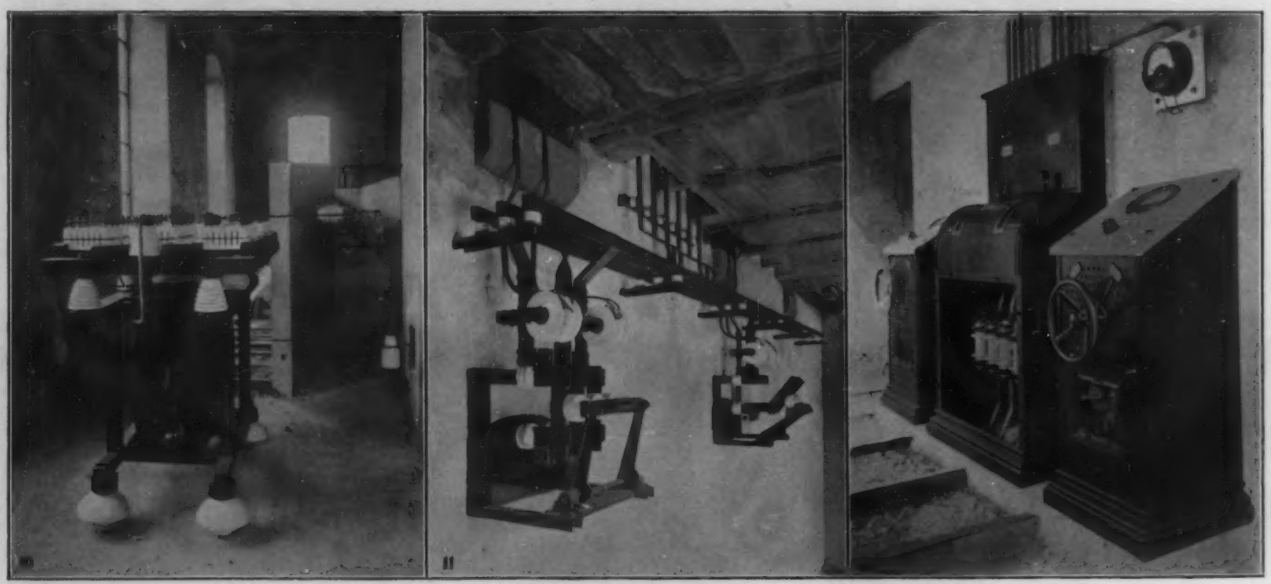
to a minimum by the methodical way in which the plant has been laid out and by the many protecting devices employed.

The central station has been built in the valley a few minutes walk from the village, and at the foot of the mountain on whose face the top part of penstock has been laid. The lower portion of the pipe line, right up to the power house, was placed underground. In the power house there are three generators of 1000 horsepower each direct-coupled to Escher-Wyss turbines by means of Todel couplings. Behind the generating sets two exciters, also direct-driven by water wheels, and each having a capacity of twenty-five kilowatts have been put down. The third generating set has been provided as a reserve in case of breakdown. The connections in the generating station have been arranged with a view to securing the maximum simplicity and economy, and differ markedly in many respects from those which have been generally adopted in Europe and in America.

The switch gear, which in installations such as the one under consideration is of the utmost importance, has been designed with exceedingly great care and forethought, and the considerable experience gained by the contractors in similar work has been brought to bear in order to render the plant a complete success.

When dealing with extra high pressures, it is bad practice to try to cramp the apparatus together; it pays to dimension everything in a liberal manner. All insulation used in this installation was of the highest grade procurable, and the distances between conductors of opposite polarity, and between conductors and earth, were left large enough to exclude all danger of the occurrence of static discharges or the formation of arcs. All the switch gear, together with the transformers, is erected in a special building adjoining the engine room. The switchhouse consists of a basement and three stories, each of the latter having a floor space of ten by seven square meters. The basement is again subdivided into two compartments, the first one being situated one and two-tenth meters below the engine room floor level, and containing the regulating resistance and framework for the 4000-volt apparatus. The second compartment is situated two and seven-tenths meters above the engine house floor, and holds the transformers. The leads from the engine room reach the first compartment through a wide trench provided under the engine room floor. The first floor is also sub-divided into two rooms; one gives access to the engine room, forming a gallery whence the whole of the installation can be surveyed. This compartment contains the main operating board with the switch hand wheels and measuring instruments; in the second room the high pressure automatic switches, together with the three current transformers for the outgoing feeder are erected. The 4000-volt conductors, the exciting leads for the generators, and the exciter leads themselves are all placed in one common trench under the floor; the second floor has been entirely taken up by the omnibus bars, and the pressure transformers connected therewith. The third floor has been reserved for the lightning arresters and the leading out arrangements of the line.

The total length of the overhead line is approximately thirty-two kilometers; it follows more or less the Serio River as it winds through the Val Seriana till Nembro is reached, where it drives the machinery of Messrs. Crespi & Co., of Milan, for treating cotton. The line has been calculated to transmit a total of 4000 horsepower, with a drop along the line not exceeding 5 per cent. The line consists of three highly conducting bare copper wires of six by five milimeters diameter each, mounted on delta insula-



SOME FEATURES OF THE NEMBRO SUBSTATION

FIGURE 10. THE WURTZ LIGHTNING ARRESTERS

FIGURE 11. THE LOW PRESSURE BUSBARS AND DISCONNECTING GEAR

FIGURE 12. THE SWITCH GEAR CONTROLLER

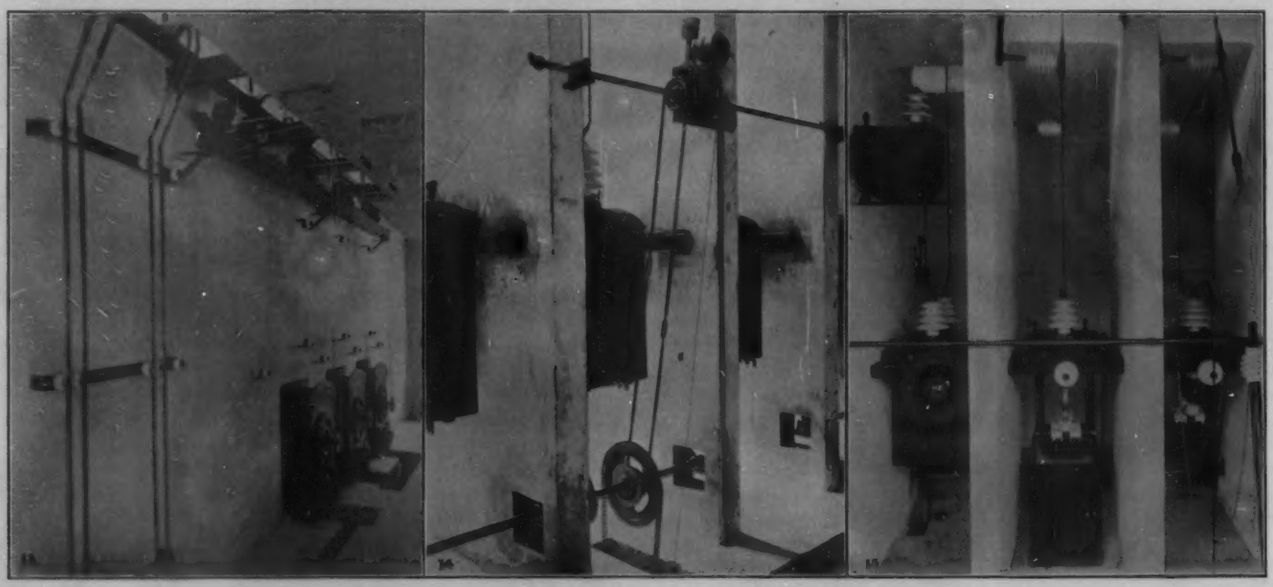
tors supplied by the well known Hermsdorf earthenware factory. These insulators, which are protected by patent, are of a totally new design, specially got out for this installation. They embody all the advantages of the ordinary delta-type insulator, but, in addition, have shown, by the following severe tests, that the spark jumped across from top of insulator to iron support at a pressure of 89,000 volts when the humidity of the atmosphere amounted to 62 per cent.; that the spark jumped across from top of insulator to iron support at a pressure of 54,000 volts when the surrounding atmosphere was subjected to a heavy artifical rain covering the ground with thirty-five or forty millimeters of water in one minute; that the insulation resistance of each insulator amounted to several millions of megohms in a dry atmosphers, and to several thousands of megohms in an atmosphere saturated with moisture to the extent of 40 or 50 per cent. Each insulator finally had to pass a flash test of 80,000 volts without showing signs of breaking down. The insulators are fixed on wooden poles and cross arms. As a rule the lines are mounted on a single pole, in the form of a triangle with 850 millimeters side. The standard height of pole is eight meters above the ground or nine meters at crossings. The lower insulators are placed at a height of seven by five meters above the ground or eight by five at crossings. Where long spans are as follows: Length, 1600 milimeters; breadth, 1155 millimeters; height, 2005 milimeters. These apparatus take thirteen litres of water per minute each for cooling purposes.

The connections of this substation, as far as the high pressure circuits are concerned, are similar to those of the Gromo station.

A three-pole emergency switch mounted on poles outside the station allows of the complete isolation of the substation. The switch is of the well known horn break type.

As the apparatus is placed in the open, the possibility exists that, when the substation is switched out, discharge of current might be produced between the live line and the line entering the transformer station. This could happen through the presence of a foreign body such as a bird, between the horns, or in very rainy weather. To avoid this sparking across occurring, three contacts have been fixed to the switch, which, when the same is opened, short circuit the lines entering the station and connect them to earth.

The line enters the substation in identically the same way as it leaves the primary station at Gromo, and the current passes through the lightning arresters to the high pressure busbars. The leads from the busbars pass through three single-pole disconnectors, and three single-pole automatic high pressure oil switches



SOME FEATURES OF THE GROMO STATION

FIGURE 13. REAR VIEW OF THE MAIN SWITCHBOARD

FIGURE 15. FORTY-THOUSAND-VOLT OIL SWITCHES

FIGURE 14. AUTOMATIC RELAY

and sharp bends occur, two poles have been erected and the insulators mounted on the cross beam at a distance of 1000 millimeters from center to center. The longest span is 120 meters and the sharpest angle 145 degrees.

At San Carlo the line crosses an existing single phase line of 2000 volts, and at Albino a line and a canal. The average length of span from pole to pole is forty meters. A telephone line connecting the power house with the substation is fixed on the same poles at a distance of one and five-tenths meters below the high pressure main line. This line consists of two silicium bronze wires of three millimeters diameter each, mounted on ordinary insulators.

The above transformer station is situated at Nembro in close proximity to the factory. The line enters the building at a pressure of 38,000 volts, this being the voltage to which Gromo has to regulate the generating plant. This station so far only contains two 500 kilo-volt ampere transformers. Space has been reserved for a third. These apparatus have been designed for a normal continuous output of 500 kilo-volt amperes. The ratio of transformation equals 38,000 to 500 volts, which at Gromo it equals 4000 to 40,000 volts. The overall dimensions of these transformers to the primary side of the transformers. The secondary side of the transformers is again provided with three-pole disconnectors and two current transformers. The busbars are connected with two feeder circuits for supplying the motors, etc. A large dial voltmeter indicates the busbar voltage. Each feeder circuit is provided with a switch and the necessary fuses.

The transformer station is a plain two-storied building. Both floors are subdivided each into two compartments. On the ground floor at the back the transformers are situated; in the front room, mounted on the separating wall, are the secondary busbars with the disconnecting gear and current transformers.

Immediately above the transformers on the next floor are the high pressure automatic switches; these are identically the same both in regards construction and *modies operandi* as those installed at Gromo. In the front room there are at present two desk type panels for the high pressure oil switches and a distributing panel for the 500-volt feeders. The latter carries two 500-volt switches and the necessary fuses.

The desk panels are an exact reproduction of the Gromo board; the ammeter is let into the marble and fed from the secondary

terminals of the current transformers connected with the secondary busbars. The framework of the 500-volt distributing panel is self-contained and is constructed entirely of iron. All current carrying parts are protected by iron sheeting against interference. The low pressure busbar voltmeter is mounted on a separate small marble panel.

The feeders from the distributing panel, passing through the upper chamber, leave the building overhead.

On the second floor the 38,000-volt busbars have been placed. These are duplicates of those erected at Gromo. The lightning arresters are placed in the next compartment, together with the leading in arrangements.

LATEST WORK IN THE DEEP MINES OF THE COMSTOCK LODE.

BY CARL GEORGE P. DE LAVAL.

FOR years numerous efforts have been made to unwater and explore the entire Comstock Lode. The latest arrangement in this direction has just been made by the Ward Shaft Association, consisting of a group of the middle mines, composed of Gould & Curry, Savage, Chollar, Potosi, Bullion, Alpha Consolidated, Exchequer, and the Julia Consolidated Mining Company, who own and operate nearly a mile of the middle lode. This association, through its chief engineer, Leon M. Hall, who is also superintendent of the Ward Shaft Association, awarded the most important contract for a permanent pumping installation to the International Steam Pump Company, of New York City.

It is now about twenty-six years since the largest pumps were installed in these mines, of the steam actuated type, and since then science has progressed in the development of pumping appliances to such an extent that it would be an injustice to criticize the types that were then in use, comparing them with modern up to date equipments. Besides, the reasons and causes for adopting the types then in use are now forgotten, and therefore does not fall within this article to criticize same. Suffice to say it is with great admiration we look upon the great efforts and successful designs that were applied in former years by the western engineer, W. R. Eckart, of San Francisco, before the completion of the Sutro Tunnel. The development and responsibility of successfully demonstrating that the later types of pumps will accomplish the exploring of the southern portion below the 2500-foot level has fallen on the shoulders of Leon M. Hall, chief engineer and superintendent. The northern half has already reached a depth of 2500 feet with very good returns from the deepest parts, and there are known to be large mineralized bodies below the 2500-foot level in the middle and southern parts, where the inrush of water about twenty years ago flooded all the middle mines up to the 1600-foot Sutro Tunnel level. All these levels have been idle, and it is Mr. Hall's belief that it is possible to unwater, ventilate and successfully and safely work the levels as deep as 5000 feet.

No known mining district in the world has met with greater difficulties than the Comstock has encountered, or will meet in handling successfully the various problems. The water that was encountered twenty years ago on the 2900-foot level of Exchequer Mine in Gold Hill was 170 degrees, and the temperature of station and workings about 110 degrees. After various efforts to handle this inrush of water it was finally decided to allow the water to fill to the Sutro Tunnel. About ten years ago another effort was made to unwater the mines through Crown Point incline, which also was abandoned after an expenditure of about half a million dollars, and future workings were confined to the 1500-foot level.

At this time hydraulic pumping engines were installed together with various Cornish engines, all of a capacity to keep the water at 3300-foot level in the north mines, but the expense of operating was so great that the mines were allowed to fill up to the 1600-foot level and workings were confined to the more accessible ore bodies above Sutro Tunnel. The fact that the character of deposits which were worked at higher levels will continue at the lower levels has induced the mining companies to make every known effort in order to reach them. Therefore, about four years ago a large hydraulic lift was installed at the Consolidated California Shaft, and with this appliance the water level in the north end has been kept below Sutro Tunnel about 2350 feet, and considerable amount of valuable ore has been taken out, amounting to over $1,000,000.00. Having reached this level another effort was made to go lower, installing an electric pumping plant of the most modern type, consisting of three Reidler electric pumping engines driven by a 200 horsepower induction motor for each. These pumps take the water at the 2150 foot level and together discharge 4500 gallons per minute into the Sutro Tunnel under 430 foot head. The hydraulic pumping engine serves as a sinking pump, discharging into tank at Reidler pump.

The application of electricity on the Comstock, not only in pumping but hoisting and general use for mining, was introduced about four years ago by Leon M. Hall. The power is generated by Truckee River, about two miles east of Floriston. McCormick turbines are directly connected to Westinghouse three-phase generators of the revolving armature type. Each pair of wheels will develop about 1400 horsepower under hand of eighty-four and one-half feet. Regulation is effected through Lombard governors. The generating potential of 500 volts is raised to 24,000 volts by Westinghouse oil insulated transformers. The current is transmitted about thirty-five miles to Virginia City over a double circuit of copper wire. The mining companies purchase power from the Truckee River General Electric Company, the amount used being based upon peak load to two minutes duration when the electric hoists are operated directly upon the lines. The price is $7.00 per horsepower per month. There is about 2000 horsepower installed on the Comstock Lode, which will soon be increased to about 5000 horsepower, as a contract has lately been closed between the Truckee River General Electric Company, and the thirty-two mining companies comprising the Comstock Pumping Association, which calls for delivery of electric power draining the Comstock mines, lighting, hoisting, etc., the maximum amount being 5000 horsepower, and in order to fill these contracts for additional power the Truckee River Company has prepared plans for a second electric generating station and a new pole line. Water will be diverted from the Truckee River and conducted to the extreme eastern end of the company's hydraulic system ,where it will be utilized by water wheels under head of forty one feet. For the maximum of 5000 horsepower rate will be $4.50 per horsepower per month with proportional rates for lesser amounts. This is based on meter readings, and will save the mining companies a considerable amount of money compared with the existing contract. All motors fifty horsepower and over are operated directly on 2240 volts, all smaller motors on 440 volts, and the lighting circuit is 110 volts, except Gould & Curry, which is on 220 volts, three wire system.

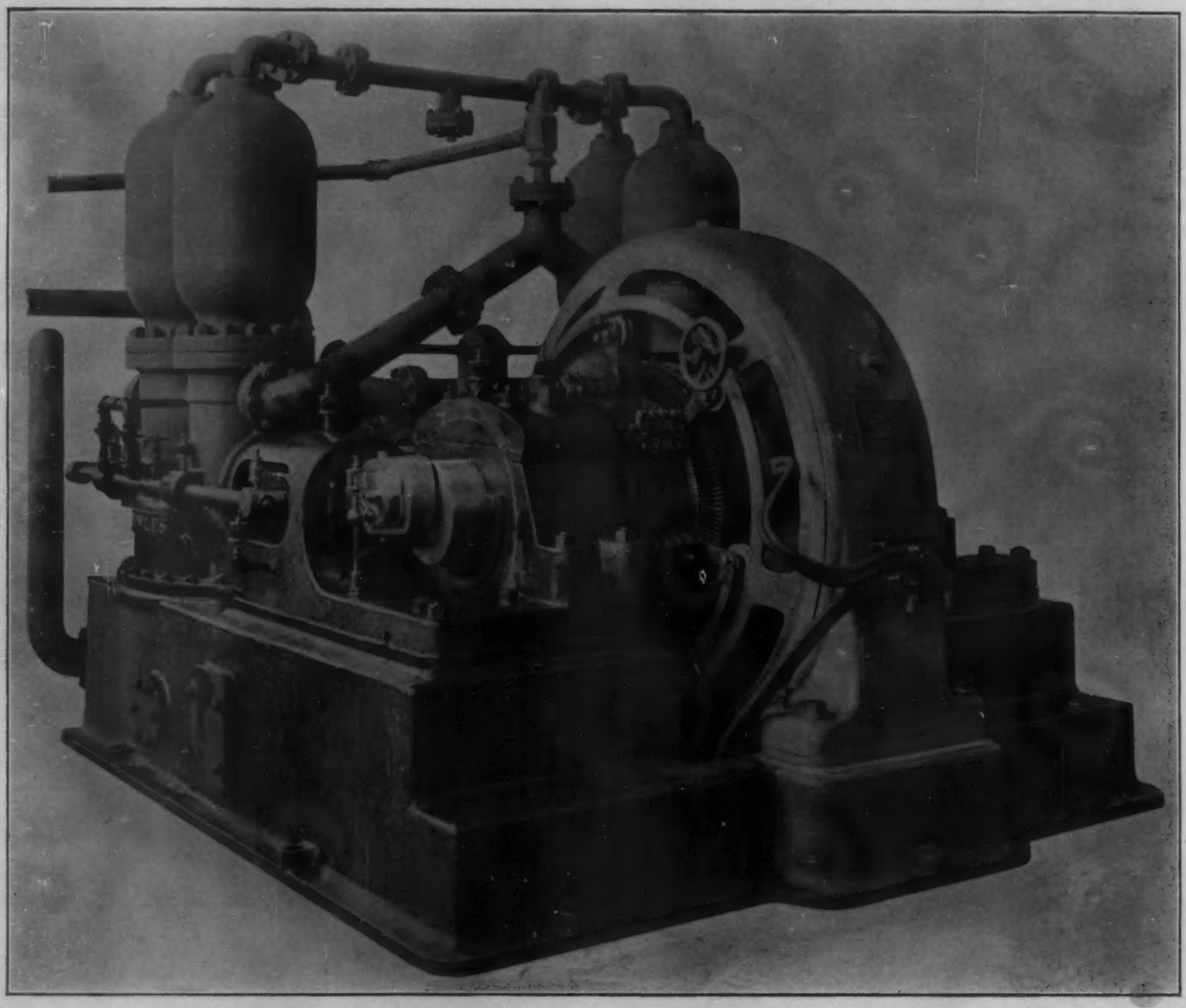
The ventilation in the mines is of the best, as it must be owing to the excessive heat and saturation from hot water. Most of the ventilation is of the natural type through various shafts on the different levels. The cold air is forced by electric fans to the different headings and stations.

The electric hoisting engines are of Mr. Hall's design and the most complete, satisfactory and economical that can be found, and was accomplished by adopting the balanced or tail rope system of hoisting.

The reason for installing the Reidler pumps at the C. & C. shaft in 1902 was on account of inability of going any further than 450 feet below Sutro Tunnel level with the power from the hydraulic water supply for the hydraulic elevators, which proved a most practical sinking pump, although efficiency is only 25 per cent., but cost of repairs is small and this type of sinking pump s fully as reliable as any other appliance for this purpose. The Reidler electric pumping plant handles not only the mine water but also pressure water when the hydraulic elevators are used for sinking. However, when the shaft is free from water another electric pumping plant is intended to be placed at the 2550-foot level, abandoning the use entirely of the hydraulic elevators. The Reidler pumps are of the mechanically operated type and

work at 110 revolutions per minute. It is a gear which is well adopted to its class of pumps at the time it was installed and accomplished its object for high speed when first introduced. The positively driven controlled pump valves were no doubt placed on the basis of commercial advantage, because of those pumps that have been fitted with same in many instances the positive valve gear has been removed and the pumps have been operated with equally as good success without the gear. An instance of this is a pumping engine designed by the writer having positively closing valves running at a speed of 600 feet a minute, and which gear was removed for an experiment to determine the capability of the engine running at same rate of speed with out the positive valve gear. The valve gear was entirely removed and on account of the successful operation without it has been running three years without this with very slight alteration in arrangement of valves themselves. The results have conclusively proven that high speed pumps don't require positively closed valve gear and same cannot be operated higher than 130 to 150 revolutions, while properly constructed poppet valves are operating as high as 300 revolutions without some of the defects natural to the poppet valves. Various engines have been designed by writer and are now running 600 to 800 feet without positive mechanism, showing that water hammer caused by backward flow at the end, which causes valves to seat hard, can be removed without application of mechanically moved valves if properly designed in relation to water spaces, air chambers, and passages. Some designers advocate mechanically closing both inlet and outlet valves, while others favor mechanically opening. Again some constructors mechanically operate but one set of valves. Such mechanism are useless and lead only to trouble and expense. Simplicity as far as possible is a desirable feature in all constructions.

In determining the type and design for the Ward Shaft the association were able to select the plant from the best type of pumping machinery in the world, considering the electric motor and pumping engine as a whole unit. It is a well known fact that motors designed for such slow speed as 100 revolutions of such large capacity will give a very low power factor, and that one of same capacity running 200 revolutions would give about 15 to 20 per cent. better results, which means the amount of power saved at the generating station and less cost for operating, and on this basis high speed 200 revolution pumps without mechanically operated valves were selected.



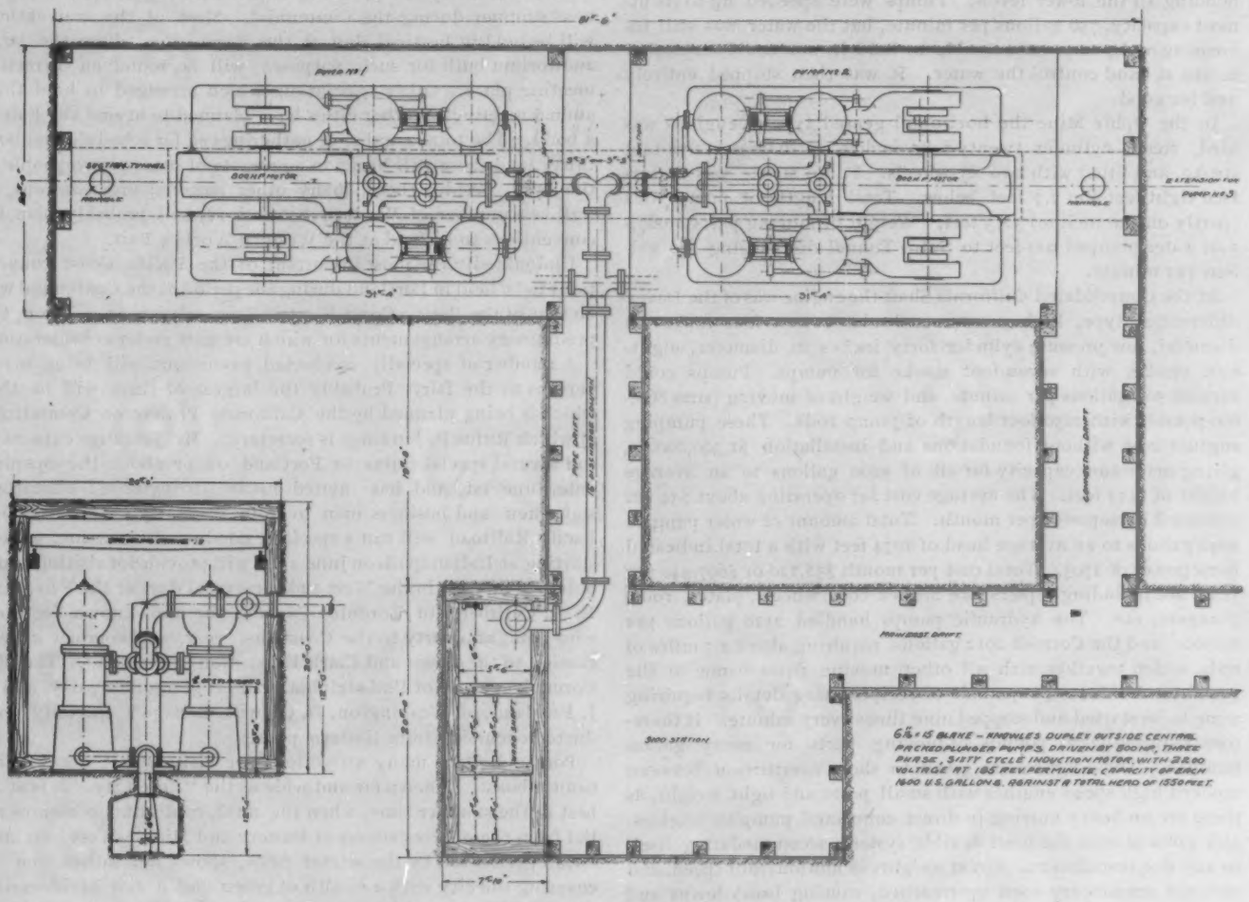
THE BLAKE-KNOWLES EXPRESS PUMP

The International Steam Pump Company was represented by Messrs. Charles C. Moore & Co., engineers, its Pacific Coast agents, and its chief engineer, Carl George P. de Laval, who came to Virginia City especially to carefully investigate the situation of Comstock Lode, Leon M. Hall, chief engineer and superintendent for the Ward Shaft Association conducting negotiations for the last named association. The contract calls for two first motion electrically driven pumps, each of the units to have

a capacity for lifting 1600 gallons of water per minute against a pressure equivalent to a height of 1550 feet, or from the 3000-foot level up to the level of the south lateral branch of Sutro Tunnel.

Each pump is to be driven by 800 horsepower Westinghouse slow speed induction motor. The contract includes column pipe, traveling crane for the pumping station, automatic oil system, small air compressor for filling air chambers, a small vacuum pump operated by compressed air for discharging air from the suction chamber, all the piping and valves of every description for completing the installation, and a complete set of duplicate parts of the pump.

It is intended to install a temporary drainage plant at the Ward Shaft, first using an air lift to lower water to the 1800-foot level, and thence down to the 2500-foot level with other pumps. The present bottom of the shaft is at the 2500-foot level, and when that point is reached the shaft will be sunk through the solid rock to the 3100-foot level where the permanent pumps just contracted for will be installed.


PUMP NO 1
PUMP NO 2
800 H.P. MOTOR
800 H.P. MOTOR
EXTENSION FOR PUMP NO 3
PUMP DRIFT
CONNECTION DRIFT
MAIN EAST DRIFT
3100 STATION
6½×15 BLAKE-KNOWLES DUPLEX OUTSIDE CENTRAL PACKED PLUNGER PUMPS, DRIVEN BY 800 HP, THREE PHASE, SIXTY CYCLE INDUCTION MOTOR, WITH 2200 VOLTAGE AT 185 REV. PER MINUTE. CAPACITY OF EACH 1600 U.S. GALLONS, AGAINST A TOTAL HEAD OF 1550 FEET.

ARRANGEMENT OF PUMPING STATION ON THE 3100-FOOT LEVEL

A descriptive cut of similar type of pump is shown herewith, which embodies all the details of the ones for the Ward Shaft. Pumps of this type are built in capacities from 200 to 4000 gallons per minute and for heads from 100 to 2000 feet. Speed of pumps in the accompanying installation is 300 revolutions per minute, efficiency of pump alone 95 per cent., motor 92 per cent., combined efficiency 85 per cent. The entire machine is self-contained, mounted on a rigid box girder frame, and occupies a relatively small space. It contains many novel features of construction, and the most careful attention has been given to the design of the internal portion as well as to the running parts and oil devices. Its operation is practically noiseless under all conditions and unaccompanied by slightest shock or heating. The weight of both pumps for the Ward Shaft and their motors is about 600,000 pounds, which may be interesting for comparison with the older pumps at Comstock.

The Ward Shaft electric pumps will have capacity of 3200 gallons against 1500-foot head, and cost $80,000.00. The Mexican Union pumping engine is a Cornish type compound condensing fly-wheel, Leavitt arrangement of cylinders, fly-wheel thirty-six feet in diameter, which fly-wheel with its shaft alone weighed 208,700 pounds. High pressure cylinder sixty-four inches diameter by six feet nine inches stroke, low pressure cylinder 100 inches diameter, eight feet six inches stroke. Nominal stroke of pump ten-feet. This engine was constructed in 1880 with a double line of fourteen-inch plunger pumps, discharging into Sutro Tunnel. Later the fourteen-inch pumps were replaced by seventeen-inch and additional eighteen-inch pump rods were added about 1000 feet long. The pump rods from top bob to the 2700-foot level were 2618 feet long. The total weight of moving parts was 1,620,500 pounds. Total lift of water 1180 feet to Sutro Tunnel from 2700-foot level station. Due to the great length of pump rods the effective stroke of plungers was reduced from the surface stroke of ten feet to actual stroke of 9.7 feet.

The Chollar, Norcross and Savage shaft, Belcher and Overman were all of the compound vertical condensing engine, Davey type. High pressure cylinders thirty-two inches in diameter, stroke ten feet nine inches, low pressure cylinders sixty-five inches diameter, eight-foot stroke. No fly-wheels are used on this type, and strokes are variable as in any direct acting pumping engine. These pumps force water from 3180-foot level to Sutro Tunnel 1570 feet. Total weight of moving parts 1,37,4900 pounds.

In the underground station at 2400, 2600 and 3000-foot levels of the Comstock shaft hydraulic pumping engines were used The ratio of power plungers to pump plungers was proportioned so pumps could make six to seven strokes per minute.

In the Yellow Jacket shaft a pump was installed in 1880, which at that time was considered the best of any. The type of engine was horizontal compound fly-wheel design, high pressure cylinder thirty-one inches in diameter, low pressure cylinder sixty-two inches in diameter, stroke twelve feet. The balance bob was so constructed that pump cylinders would receive ten-foot stroke. This pumping engine took the water from the 3000-foot level pumping same direct to the surface, having total length of pump rods of 3055 feet. Weight of the moving parts 1,510,400 pounds. Engine made five and one-half revolutions when 432 gallons. An accident occured to this engine closing same down until the Sutro Tunnel was completed, when it was changed by a double line of pumps raising the water 1516 feet to Sutro Tunnel and pumping 700 gallons per minute. About a month later a heavy flow of water from the 2900-foot level of Exchequer Mine was encountered, flooding all the lower levels. Pumps were speeded up to its utmost capacity, 750 gallons per minute, but the water was still increasing and pump was not able to hold it, nor could any other means at hand control the water. It was then stopped entirely and for good.

In the Ophir Mine the horizontal geared type of engines was used, steam cylinder twenty-four inches in diameter, five-foot stroke, and fitted with two fly-wheels. Pump stroke was at surface eight feet and 7.7 feet below. Total length of pump rods (partly on the incline) 3273 feet. Weight of moving parts 1,067,500, water pumped 900-feet to Sutro Tunnel discharging 280 gallons per minute.

At the Consolidated California Shaft the engine was of the Davey differential type, high pressure cylinder twenty-four inches in diameter, low pressure cylinder forty inches in diameter, eight-foot stroke, with seven-foot stroke for pumps. Pumps could furnish 500 gallons per minute, and weight of moving parts 860,000 pounds with 2150-foot length of pump rods. These pumping engines cost without foundations and installation $1,300,000.00, giving maximum capacity for all of 5400 gallons to an average height of 1152 feet. The average cost for operating about $34 per indicated horsepower per month. Total amount of water pumped 5040 gallons to an average head of 1074 feet with a total indicated horsepower of 1703. Total cost per month $58,120 or $697,440 per year, not including repairs like broken bob, wheels, plates, rods, plungers, etc. The hydraulic pumps handled 2128 gallons per minute, and the Cornish 2912 gallons, requiring about 2.7 miles of rods, which together with all other moving parts came to the grand total of 6,496,400 pounds of reciprocating details requiring same to be started and stopped nine times every minute. It therefore required 2230 pounds of moving parts for every gallon pumped. These figures are given to show comparison between modern high speed engines with small parts and light weight, as there are no heavy moving in direct connected pumping engines, and gives at once the most flexible system, accommodating itself to any size installment. Great weights in motion limit speed, and material stresses are soon overreached, causing breakdowns and repairs. The old Comstock pumps could not be increased in capacity, as extra weight brought reduction of speed, which was experimented on at the Mexican Union, where speed had to be reduced to about four revolutions per minute on account of overstraining rods, which were eighteen inches by eighteen inches Oregon pine and 2618 feet in length. Owing to the extreme hot water (170 degrees) and saturated temperature of shafts, the machinery and parts had to be constantly lubricated to an excessive extent, requiring careful watching for rotting of pump rods, rusting of wrought parts, and destruction. The cost of maintenance and power was enormous, and could not continue with the advent of new methods and devices, with the demands of shareholders for more dividends, and newer and better types of machines were looked for, and when the C. & C. electric pumps were started a new era dawned upon Comstock Lode, which will be followed up by the installation of permanent Knowles electric Express pumping engines just contracted for, which will drain the group of the middle mines upon the Comstock Lode to a depth of 3100 feet through the Ward Shaft.

The awakening of Comstock is now a matter of fact, and if statistics are to be relied upon the mineral deposits of this famous and marvelous camp have not yet been uncovered, and many a fortune will still be in store for our children, and history written of soul stirring events. Again the rugged slopes of Mt. Davidson will be clustered by mines, as the only hindrance to progress has been the water, which is now solved, with Virginia City thriving and prospering under permanent conditions.

THE CONVENTIONS OF THE PORTLAND EXPOSITION.

ATTRACTED by the prospect of a trans-continental trip, by the fame of Portland as one of the most beautiful cities in the United States, and by the stories of great things to be seen at the Lewis and Clark Exposition, many associations of land-wide membership are planning to hold conventions at Portland next summer during the Centennial. Most of the conventions will be held in Festival Hall at the Exposition, where the large auditorium built for such purposes will be found an attractive meeting place. Other associations which arranged to hold their annual meetings at other cities have planned to attend the Fair in a body. The total number of gatherings so far scheduled is about thirty, and these will bring an aggregate of some 30,000 people to the Fair. Besides these, many other national organizations, as well as a number of Western associations, will probably plan for conventions to be held at the Western World's Fair.

Undoubtedly the most important of the Pacific Coast conventions to be held in Portland during the period of the Centennial will be that of the Pacific Coast Electric Transmission Association, the preliminary arrangements for which are now under consideration.

A number of specially conducted excursions will bring many persons to the fair. Probably the largest of these will be that which is being planned by the California Promotion Committee, of which Rufus P. Jennings is secretary. Mr. Jennings expects to run several special trains to Portland on or about the opening date, June 1st, and has invited many distinguished educators, statesmen and business men to join the party. The Missouri-Pacific Railroad will run a specially conducted excursion, which, starting at Indianapolis on June 25th, will provide for visiting many points of interest in the West and for several days at the Fair. Mrs. E. M. Cuthbert, of Toronto, Canada, the well-known lecturer, who brought a party to the Coast last year, will conduct an excursion to the Lewis and Clark Exposition at Portland. The McCormick agency, of Philadelphia, will bring another party, and J. J. Freeland, of Washington, D. C., will manage a specially conducted excursion from Eastern points.

Portland offers many attractions for visitors that other cities cannot boast. Known far and wide as the "Rose City." it is at its best in the summer time, when the mild, cool climate assures relief from the oppressiveness of Eastern and Middle-West heat, and nature, refreshed by the winter rains, shows her satisfaction by covering the city with a wealth of green and a riot of blooming flowers. The exposition, though much smaller than that held at St. Louis, will be in many ways more attractive, being compactly laid out, and designed to emphasize to Easterners the wealth and greatness of the Western country. Hotel accommodations in Portland are of the best, and no extortion will be permitted. Besides a large number of first class hostelries, the city is covered with lodging houses, and thousands of people will open their homes to visitors at a reasonable rate.

GUARD AGAINST EXTORTION.

UNTIL quite recently one of the most perplexing questions in connection with the general plan of the Lewis and Clark Exposition was that of providing visitors with suitable accommodations at reasonable rates and preventing extortion. This question has been solved by the organization of a bureau of accommodation incorporated under the general laws of the State of Oregon, under the supervision and control of the latter. It has been the experience of other cities where great expositions have been held in the past that visitors have been held

up by unscrupulous and grasping landlords in spite of all that has been done to prevent it. The primary purpose of this bureau will be to offer rooms in the better class of private homes convenient to car lines, but, it is in the field to provide any and all kinds of respectable and suitable accommodations, so that no person need visit Portland's great fair and complain of any dereliction of duty on the part of the citizens in the matter of providing accommodations in keeping with their needs.

The bureau will make reservations of whatever accommodations may be desired at any time before or after the fair opens. Those contemplating a visit to the great Western fair will do well to make their reservations as far ahead as possible even into the fall of this year. The bureau will maintain a central office with branch offices distributed about the city in the most convenient and accessible localities.

ON ELECTRIC SERVICE COSTS.

BY SIDNEY SPROUT.

IT is frequently necessary to reduce kilowatt costs per year to kilowatt-hour costs, or *vice versa*, and to do so entails calculations that though simple are irksome. Such costs, of course, depend upon the hours of daily service rendered, and in ascertaining them it has been found convenient to reduce them to a tabulated form for ready reference, when they appear as follows for daily services amounting to ten, twenty-one and twenty-four hours respectively:

Cost Per Kilowatt-Hour.	Cost Per Kilowatt-Year—Hours Per Day,		
	10	21	24
$0.015	$54.75	$114.97	$131.40
0.0145	52.92	111.14	127.02
0.014	51.10	107.31	122.64
0.0135	49.28	103.48	118.26
0.013	47.45	99.64	113.88
0.0125	45.62	95.81	109.05
0.012	43.80	91 98	105.12
0.0115	41.98	84.15	100.74
0.011	40.15	81.13	96.36
0.0105	38.33	80.48	91.78
0.010	36.50	76.65	87.40
0.0095	34.68	72.82	83.22
0.009	32.85	68.98	78.84
0.0085	31.02	65 15	74.46
0.008	28.20	61.32	70.08
0.0075	27.37	57.49	65.70
0.007	25.55	53.65	61.32
0.0065	23.72	49.82	56.49
0.006	21.90	45.99	52.94
0.0055	20.07	42.16	48.18
0.005	18.25	38.32	43.80
0.0045	16.42	34.47	39.42
0.004	14.60	30.66	35.04
0.0035	12.77	26.83	30.66
0.003	10.95	22.99	26.28
0.0025	9.12	19.16	21.90
0.002	7.30	15.33	17.52
0.0015	5 47	11.50	13.14
0.001	3.65	7.66	8.76
0.0005	1.82	3 82	4.38

THE WESTINGHOUSE DIARY.

OF the Christmas remembrances in legion that were issued to the trade during the holiday season just closed, probably none will be greater prized than that of the Westinghouse Electric and Manufacturing Company known as the Westinghouse Diary. In addition to the information usually published in books of this character, there have been included some forty odd pages of valuable engineering information which cannot fail to prove of great assistance to all persons engaged in various lines of engineering.

PERSONAL.

Mr. Russell Robb has become a partner in the firm of Stone & Webster, of Boston, Mass.

Mr. Guillermo A. E. Larsen, of the city of Mexico, has been appointed general representative of the Swedish General Electric Company, of Vesteras, Sweden, for the Republic of Mexico.

Mr. A. J. Coffee, Jr., president of the A. J. Coffee Company, Pacific Coast agents of the Gamewell Fire Alarm Telegraph Company, has returned to San Francisco after an absence of two years or so in the Orient.

Mr. Ed. B. Parsons has resigned from the sales department of the San Francisco office of the Westinghouse Electric and Manufacturing Company in order to take charge of the machinery sales for Kilbourne & Clarke Co., with headquarters in San Francisco, in a line comprising National Electric Company's alternating and direct current generators, motors, rotaries, etc., Pittsburg transformers, overhead railway supplies, switchboards and Cutler-Hammer apparatus.

Mr. Arthur F. Salomon, originally of the Allgemeine Elektricitats-Gesellschaft, of Berlin, later manager of the offices of the same company at Paris, France, and more recently of the Nernst Lamp Company, of Pittsburg, for which he was general agent at St. Louis during the period of the Louisiana Purchase Exposition, has been appointed general agent for the Nernst Lamp Company for the Pacific Coast, to take effect from January 1st. In this appointment Mr. Salomon succeeds the Kilbourne & Clark Company, its former managers, although the place of business will remain at 519 Mission Street as heretofore.

Mr. Charles H. Baker, who founded the Snoqualmie Falls Power Company of Seattle and Tacoma, and who since its beginning six years ago has been its active president and chief engineer, and who also as manager and chief engineer has promoted and planned the White River Power Company, has sold a controlling interest in both companies to a party of capitalists who have elected N. H. Latimer, manager of the Dexter-Horton Bank of Seattle, as president. Mr. Baker is planning an early trip to Japan and China for pleasure and rest, and for the purpose of exploring the water power and electrical possibilities of those countries.

Mr. E. S. Lea, who is known as an authority on the subjects of turbines and centrifugal pumps, has resigned his position as sales manager for the De Laval Steam Turbine Company and has opened an office at 42 Broadway, New York, as consulting engineer. Mr. Lea, prior to his four years' connection with the De Laval company, had a wide experience in the designing and construction of power plants, water works and in the manufacture of general machinery. The recent development in the uses of the steam turbine and the centrifugal pump and the lack of exact knowledge among engineers regarding the capabilities and limitations of the various types now on the market, seem to assure a large measure of success to Mr. Lea, who is the first to enter this important field as an independent consulting expert. Mr. Lea is a member of the American Society of Mechanical Engineers and an associate member of the American Institute of Electrical Engineers and of the American Society of Naval Engineers.

A SAN FRANCISCO CHAPTER ORGANIZED.

THE San Francisco branch of the American Institute of Electrical Engineers was organized here on January 20, 1905, by the election of the following executive committee: George O. Squier, C. L. Cory, F. V. T. Lee, J. A. Lighthipe, A. H. Babcock.

The officers are: George O. Squier, chairman; C. L. Cory, vice-chairman; A. H. Babcock, secretary. Meetings will be held at stated intervals for discussion of the Institute papers, and such original papers as may be presented. It is expected that all who are interested in the subjects will attend, whether they be members of the Institute or not.

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EDITORIAL.

ON HIGH TENSION DIRECT CURRENT TRANSMISSIONS.

Were an electrical engineer asked to define in a single word the feature of alternating currents which has more largely predetermined its all but universal use in long distance high tension transmission practice, he would undoubtedly reply "flexibility." True it is that there are other factors of potency such, for instance, as absence of commutation in both generators and motors, but above all there will rise pre-eminently the fact that the alternating current transformer enables the safe conversion of currents from one potential to another to any desired degree, and in so doing achieve economies in transmission to practically any desired extent, nevertheless the concensus of advantage is not all with alternating current, for the applications of electricity requiring direct currents make necessary the use of motor-generators or rotaries which are at least not unmixed blessings from standpoints of efficiency, first cost, and attendance. In fact, were no difficulty experienced in the commutation of direct currents at high voltage, it is possible in the light of the interesting tests about to be related that direct currents would find a sphere of usefulness in transmission practice on a scale hardly less restricted than that now held by alternating currents.

During the summer just closed the Conpagnie de l'Industrie Electrique et Mecanique, of Geneva, Switzerland, has been carrying out a series of high tension transmission experiments wherein direct currents were used exclusively and wherein a line of experimentation of an original nature was devolved. Prior to this experiment, the highest direct current voltage used in transmission service existed on the St Maurice-Lausanne line wherein a 23,000-volt dynamo delivers 150 amperes in direct current to the transmission service. In the latter experiments three generators similar to those used on the St. Maurice-Lausanne line were coupled together in series and operated at the remarkably high tension of 70,000-volts direct current. As might have been expected, such a high potential gave rise to some interesting results, but the aim of M. Thury, chief engineer of the company named, was to determine the limiting voltage. The problem to be solved naturally became largely a question of installation, and the first portion of the tests consisted in ascertaining how standard forms of line insulators would behave under a direct current tension of 70,000 volts, and secondarily, to compare the behavior of similar direct current and alternating current pressures. The results go to prove that direct current is superior to alternating current in its attitude toward porcelain insulators as well as toward different kinds of insulating materials in general. In particular did they demonstrate the feasibility of applying direct currents in the solution of modern engineering problems such as aerial telegraphy and the manufacture of nitrogenous products from the air. It is a matter of regret, however, that the experiments did not touch on the most difficult feature of employing direct current at high voltage, namely, that of the commutation of heavy ampereages.

These columns are indebted to a well known European correspondent, Mr. Emile Guarini, for the information which they give, and in the data supplied he points out that if one admits the use of direct current, allowing a loss of 10 per cent. in the line and a weight of copper amounting to sixty-six pounds per electrical horsepower delivered from the line, an initial pressure of 4200 volts will be required for six miles of line, 42,000 volts for sixty miles and 420,000 volts for 600 miles, thus possessing an important advantage over the approximate rule of 1000 volts per mile so generally accepted in alternating current practice. The use of the earth as a return conductor admits of the doubling of these distances for equal voltages, loss and weight of copper, or on the other hand, of reducing the voltage by one-half in each instance. Contrary to this, the use of alternating current of the pressures given reduce the respective line lengths because of secondary phenomena which increase the line losses. The insulators that were submitted to the direct current test did not heat to any appreciable degree. Such was not the case with alternating currents and the effect is explained in part by the absence of capacity effects with currents of the first named variety. All insulating substances which were tried gave similar results. At the breaking point the direct current voltages were always double those of alternating currents and where capacity plays an important part, the difference is still greater. This points conclusively to the fact that in the industrial uses of higher electric pressures, the difficulties attending the use of direct currents are much less than those encountered with alternating currents provided the problem of commutation be neglected. Experience has demonstrated the correctness of this assertion in several European transmissions. Furthermore, the transmission of

electrical energy for industrial uses over a distance of several hundred miles is thus brought materially nearer to consumation. It is not supposed in the test referred to that the industrial limit of voltage has been reached, for the trend of the experiments was such that the use of 100,000 volts in direct currents is believed to be possessed of commercial feasibility. The derivation of this potential will be found in the connection of four of the present 25,000-volt machines in series, a combination which does not appear to present any special difficulty.

The porcelain insulators under test were provided with ordinary iron fittings and only a small number of the smaller size insulators were perforated. In most instances the disruptive spark occurred on the exterior of the insulator between the tie wire and the iron pin. The insulators that were perforated by alternating current were, despite their previous perforation, still able to resist very high direct current pressures in the laboratory, but when exposed to rain the limiting direct current voltages were generally lowered about one-half. It was noted that there was scarcely any crackling noise when break-down pressures were approached, but the reverse was true with alternating currents. In the same way brush discharges are hardly appreciable with direct currents except when explosive distances are nearly reached. It was not found possible to pierce the porcelain insulators used in telegraphy even at 65,000 volts direct current, and other insulators used in high tension European practice under moderate pressures were equally invulnerable. All porcelains under test were well vitrified and homogeneous, the thicknesses of their walls appearing to be of little consequence, for it is pointed out that as long as pressures are confined within the sparking distance the thickness of the walls sufficed, and as this distance is shorter with direct current, an explanation is given why direct current pressures must be so much higher than alternating currents in order to effect a break-down. Glass is very difficult to pierce with direct current. Ordinary white glass of a thickness of 0.12 resists very well at 28,000 volts and is only perforated when an oscillatory discharge is formed by means of a condenser. A sheet of window glass will invariably resist 60,000 volts in direct current, but of the thickness of this glass, no information is at hand.

THE QUESTION OF FREQUENCY.

When, some decade and a half ago, alternating current practice was in its literal infancy and naught concerning it was known save of single phase high frequency applications, direct currents held all but full sway in the domain of electrical development. Each system had its own advocates, and in the battle for supremacy which followed alternating currents found that a formal obstacle to their advance existed in their inability to compete with direct current in the transmission of power. Then came the development of polyphase currents and the invention of the induction motor; whereupon, in the course of time, the newer system rose to at least an equal plane of importance with the old. But at that time alternating current methods were operated on a high frequency basis, that is at a frequency of 125 or 133 cycles per second—a frequency that is too high for power transmission purposes—and soon the necessity was realized, though not without some considerable ill-nature, that lower frequency apparatus must be installed to meet the new conditions. Gradually sixty cycle machinery has displaced the older types until now a periodicity of 133 cycles in any plant is an evidence of its antiquity. Indeed, the adoption of still lower frequencies down to twenty-five cycles was at that time generally regarded as ultra-conservative, even in plants designed principally for the transmission of power without lighting service—such, for instance, as those at Niagara and Montmorency—while on the Pacific Coast the original twenty-five cycle installation consists of that of the United Railroads of San Francisco erected in the fall of 1903.

One of the most interesting topics brought up for discussion before the Seventh Annual Meeting of the Pacific Coast Electric Transmission Association was found in the paper by W. F. Lamme on "A Coming Problem for the Pacific Coast Engineer,"* wherein he pointed out briefly the influences exerted by frequencies of various degrees on the transmission capacity of given lines, and which he argued were overwhelmingly in favor of low periodicities. Then he very pertinently asked how the number of alternations common in existing transmission practice could be changed from high to low. Mr. Lamme's paper was discussed with more vigor than approbation; it was contended that the suggestion was without newness; that low frequencies meant heavier and consequently more expensive generators and transformers; that neither arc nor incandescent lamps operate satisfactorily at low frequencies; that the carrying capacity of a given line so far as the power loss is concerned is a function that is altogether indifferent as to frequency, and that, in brief, the advantage to be derived from low frequency would be one of regulation, pure and simple, more than anything else. Indeed the discussion referred to forms very interesting and instructive reading.†

With the lapse of time changes of condition are working changes of proceedure, and verity is being given to Mr. Baum's statement in the discussion referred to wherin he says that "unquestionably, so far as the line itself is concerned, a frequency of thirty cycles would be better than sixty cycles, and a frequency of zero would be better than either," a fact which is emphasized strongly in the leading editorial of this issue. But in the Far West it has heretofore been the rule that conditions have been unfavorable to low frequency transmission, particularly because loads have been predominatingly of lighting natures, with power as an incidental service. Gradually these conditions are being reversed—lighting is becoming

*THE JOURNAL, Volume XIII, page 261, July, 1903.

†*Ibid*, Volume XIII, page 286, August, 1903.

incidental, power is predominating and the gulf between them is widening rapidly, so that it is safe to stay that the majority of the great transmission properties of the country would be in better physical condition today were they of say the twenty-five cycle type—this for the reason that they have passed the stage of growth where their lighting services are incidental with those of power. Then, too, the demand for good regulation casts its potent influence in favor of low frequency.

Whatever there is of disadvantage arising from the necessity of lowering the frequencies of existing transmission systems, that much is directly chargeable as a penalty of pioneering development. It typifies one of the several periods through which any new industry must pass by reasons of "advances in the art"—and it typifies further the necessity for the carrying of a depriciation account. Gradually the 133 cycle machinery of Nevada County, Cal., is being superseeded by 60 cycle apparatus, and now, in order to fulfill its contract with the United Railroads of San Francisco, the California Gas and Electric Corporation has given contracts for two 5000-kilowatt Stanley frequency changers to reduce its transmission periodicity of sixty cycles to twenty-five cycles, as well as for four 4000-kilowatt twenty-five cycle Crocker-Wheeler generators to be contained in its San Francisco substation, all as these columns have heretofore related. Of the total generating capacity of say 90,000 horsepower installed and contracted for by the California Gas and Electric Corporation, already 15,000 horsepower therefor, or about 17 per cent., is of twenty-five cycle apparatus—and this percentage will ever increase as the use of electric power becomes more and more universal.

But the credit for far sightedness in installing the first low periodicity transmission plant in California for general commercial service rests within the North Mountain Power Company, whose chief engineer, J. C. Ralston, has long appreciated the fact that electrical development would soon outgrow those old conditions wherein electric power is secondary in importance to electric lighting. The transmission system which this company has just placed in operation in Humboldt and Trinity counties of this state forms the subject of the leading article of the present issue of THE JOURNAL, and which is particularly interesting not only for the feature stated, but also from the fact that it proves the abiding faith held by capital in both the future of the industrial importance of the Humboldt Bay region as well as in the inevitable destiny of electric power service in supplying practically every need for mechanical energy. The boldness of this undertaking, together with proof of the sound logic that has saturated the conclusions which eventuated in building the plant, become all the more striking when it is realized that service is being delivered throughout the territory where lumbering forms the principal industry, and where, therefore, wood fuel in the shape of sawdust and slabs may be had almost for the asking. The installation presents a case wherein the cost of transmitted power, consisting of interest on the investment plus attendance and fixed charges, becomes less than the cost of power generated by steam, consisting of investment plus attendance plus fixed charges; in fact it has been demonstrated that sawdust fuel in Eureka posesses no advantage over crude oil fuel even through sawdust costs nothing and is handled automatically. Eureka is unquestionably destined to be the maritime *entrepot* of Northern California. It is a thoroughly business like city of some 12,000 inhabitants; its saw mills and woodworking industries are among the most important in the State and it is backed by a country as yet only partially developed and entirely inaccessible except by sea, yet which is already credited with being one of the greatest dairying districts of the West. Probably two years will elapse before Eureka will possess railway communication with the outside world, and in the meantime the footing that the North Mountain Power Company will have secured in Humboldt and Trinity counties which its circuits will cover will have become invulnerable, for its system has been built on a cash basis and of sound engineering design.

THE COMING N. E. L. A. CONVENTION.

ARRANGEMENTS for the annual convention of the National Electric Light Association in Denver and Colorado Springs the week of June 6th, have progressed to such an extent that the committees in charge are able to promise the best and most of everything. So successful have been the finance and arrangements committees that they can assure members and visitors that there will not be a dull moment during their stay in Colorado. Such a great number of opportunities for entertaining have become available, that this task has become one of selection rather than one of seeking means of recreation. Members of the Association have indicated their approval of the selection of a place that affords a fine summer trip in connection with the convention. Word has been received from a large number of these, each telling of big parties of members and visitors who will attend.

The interest that is being taken by the supply men indicates that they will be present in greater force than usual, and that they will submit their wares in a more comprehensive manner than ever. Some of the most skilled electrical men in the world will participate in the convention. Improved methods, new machinery and all of the other branches of the electrical business will be discussed. In arranging the side trips through the State the committee will endeavor to take the visitors to those sections that afford interesting opportunities for the study of electrical development in a mountainous country.

EXHIBITS FOR LEWIS AND CLARK EXPOSITION ARRIVING.

WITH more than three months still remaining before the opening day, June 1st, exhibits and displays for the Lewis and Clark Centennial Exposition are beginning to arrive in Portland by the car load, and are being stored in finished buildings on the exposition grounds. From this time on, the cars of exhibits will continue to arrive in large numbers until all the displays are ready for the opening of the great Coast Fair.

A cargo of exhibits for the Mines and Metallurgy Department has arrived from St. Louis, and cars containing various manufacturing exhibits are reported on their way to the Fair city.

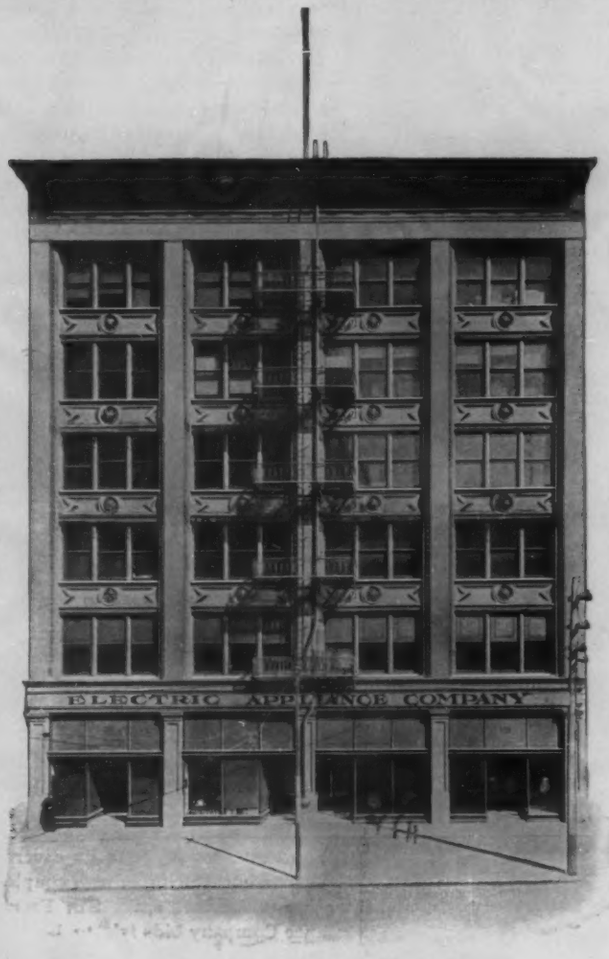
All but one of the exhibition palaces are now completed, and the arrival of exhibits at this early date makes certain the readiness of the fair on the opening day.

INDUSTRIAL

ELECTRIC APPLIANCE COMPANY.

IF the electrical supply business be considered alone without regard to extraneous influences, such as machinery sales, manufacturing interests, etc., it is undoubtedly true that the Electric Appliance Company, of Chicago and San Francisco, is the largest electrical supply house in America; that is, the magnitude of the business which it transacts in the handling of electrical supplies to the exclusion of all other related products is greater than that of any other American establishment. This is an eminence which it has attained through the consistent solici-

WILLARD W. LOW
PRESIDENT, CHICAGO



ELECTRIC APPLIANCE COMPANY, SAN FRANCISCO

THOS. I. STACEY
SECRETARY AND TREASURER, CHICAGO

tude for the welfare and interests of its customers, whom it has always satisfied by reason of its liberal policies.

The business of the Electric Appliance Company was established in Chicago, in 1890, at 242 East Madison Street. The original quarters consisted of the ground floor and basement, which was soon thereafter enlarged to the occupation of the entire building. These premises however became inadequate to enable them to properly care for their rapidly growing business, and, in 1897, they moved to the building at 92 and 94 West Van Buren Street, on the southeast corner of Jefferson and Van Buren streets. This building consisted of five stories and basement and contained a floor space of approximately 100,000 square feet. About two years later it was necessary to obtain more stock room, at which time the company secured a large warehouse on Canal Street, between Adams Street and Jackson Boulevard, using it for the storage of surplus stock.

In order to consolidate their business under one roof the Electric Appliance Company is just completing its new building at 134 to 140 West Jackson Boulevard, corner of Desplaines Street. This building, when completed, will be six stories high, with basement, occupying a ground space of 120 by 120 feet, and will be the largest building in the world devoted exclusively to the electrical supply business.

The increasing importance of its Pacific Coast business culminated in the summer of 1904 in the determination of the company to establish a branch house in San Francisco, whereupon the building situated at numbers 717 and 719 Mission Street was leased, and this building, together with some of the interior views of the premises, is illustrated herewith.

C. C. HILLIS
GENERAL MANAGER, SAN FRANCISCO

F. J. CRAM
SALES MANAGER, SAN FRANCISCO

With the exception of the production of the line of telephones known to the trade as the "Eaco" telephone, the Electric Appliance Company does not engage in the manufacture of electrical apparatus in any form. This telephone apparatus embraces a complete line of telephone switchboards and telephones for exchange work, as well as of house instruments, such as interior telephone systems for hotels, public buildings. apartments, schools, hospitals, residences, factories and warehouses. Of these above 15,000 instruments are now in use.

It has only been in the last two years that the need for carrying a complete stock of every line of electrical supplies in San Francisco has been appreciated, and the Electric Appliance Company in the establishment of its San Francisco house was among the first to recognize the necessity by stocking its premises with goods that would enable the instant filling of any order of whatever magnitude. As may be inferred, its lines of supplies are complete in every branch of the trade. On account of the Electric Appli-

1. THE OFFICES OF ELECTRIC APPLIANCE COMPANY
2. THE BASEMENT
3. WESTERLY HALF OF THE MAIN FLOOR
4. WESTERLY HALF OF THE SECOND FLOOR
5. EASTERLY HALF OF THE MAIN FLOOR

ance Company's pre-eminence in the electrical supply business, it has always been possible for it to make satisfactory selling arrangements with a large number of the leading electrical specialties on the market, and the San Francisco house is thus enable to carry large stocks of the same lines of goods that is carried by the Chicago house. For instance, the San Francisco house carries in stock a complete line of "OK" weatherproof line and house wires and cables of the Phillips Insulated Wire Company, Pawtucket, R. I.; Paranite rubber covered wires and cables of the Indiana Rubber and Insulated Wire Company, Jonesboro, Ind.; Packard incandescent lamps and Zenith prismo lamps of the New York and Ohio Company, Warren, Ohio; Packard transformers of the Packard Electric Company, Warren, Ohio; A. B. arc lamps of the Adams-Bagnall Electric Company, Cleveland, Ohio; Loricated and electro-galvanized condnit of the Safety Armorite Conduit Company, Pittsburgh, Pa.; T. & B. conduit lock nuts and bushings and Toler conduit boxes of Thomas & Betts, New York; circular loom flexible conduit of the American Circular Loom Company, Chelsea, Mass.; magnet wire and iron box bells and buzzers of Ansonia Electrical Company, Ansonia, Conn.; sockets, rosettes, cut-outs and switches of the Bryant & Perkins manufacture; glass insulators of the Hemingary Glass Company, Covington, Ky.; line materials of the George Cutter Company, of Chicago; Stombaugh guy anchors of the W. N. Matthews & Bro., of St. Louis, Mo. (the only stock on the Coast); Nungesser open and closed circuit batteries of the Nungesser Electric Battery Company, of Cleveland, Ohio; needle annunciators and house goods of Partrick, Carter & Wilkins, Philadelphia, Pa.; knife switches, volt meters, ground detectors and ammeter switches, plugs, receptacles, and cast copper terminals of the J. Lang Electric Company, of Chicago, Ill.; portable lamps, brackets, shades and reflectors, of the Faries Manufacturing Company; Oamco mirror reflectors, aluminum and tin shades and window reflectors of the Overbagh & Ayres Manufacturing Company, of Chicago, Ill.; porcelain insulators, cleats and tubes of the G. F. Brunt Porcelain Works, of East Liverpool, Ohio; Greer fuse wire and links, and telephone cut-outs, lightning arresters, fuses and cable hangers of the Harvard Electric Company of Chicago, Ill.; Partridge lamp changers, cord adjusters and reflectors of the Partridge Manufacturing Company, of Chicago, Ill.; electrical heating apparatus, such as laundry irons, tailoring irons, electrical stoves, heating pads, soldering irons, etc., of the American Electric Heating Company, of Detroit, Mich.; pocket flashlights and batteries of the American Electric Novelty and Manufacturing Company; perfection woven wire brushes; Klein's linemen's tools, such as climbers, splicing clamps, etc.; fancy glass and porcelain electric shades of the Phoenix Glass Company; torches and fire pots of the White Manufacturing Company and Turner Brass Works, besides a complete and seemingly inexhaustible supply of pole steps, cross arm braces, locust and oak pins and brackets.

This cursory resume of the electrical supplies carried in stock in San Francisco suggests its diversified scope, and with this perfect stock from which to draw, coupled with every facility for making prompt shipments, the San Francisco house of the Electric Appliance Company bids fair to become as thoroughly the leading and largest distinctively electrical supply house of the Pacific Coast as is the Chicago house that of America.

Foremost among those who have brought the Electric Appliance Company into its prominence is Willard W. Low, its president, whose advent into the electrical business dates from the days of the old Detroit Electrical Works, some twenty or twenty-five years ago. For years thereafter Mr. Low was traveling sales agent for different electrical supply houses, and his acquaintance thus gained was a principal factor in the organization of the Electric Appliance Company, of which he has always held the presidency. Associated with Mr. Low in the organization and management of the business is Thomas I. Stacey, secretary and treasurer, and to his particular executive ability is due in no small degree the success of the company.

The San Francisco house is under the general management of C. C. Hillis, another old-time electrical man, who has been with the Chicago office of his company since its inception, and has worked his way up through its different branches until he become auditor and credit man, which position he held for five years before coming to the coast. F. J. Cram, sales manager of the San Francisco office,

began his career in the electrical business with the Northwest Thomson-Houston Electric Company, of St. Paul, after which he became general sales agent of the Electrical Engineering Company, of Minneapolis. For the past eight years Mr. Cram has been sales agent for the Electric Appliance Company, traveling exclusively throughout the states of the Pacific Coast, including Montana and Wyoming.

ELECTRO-LIFTING MAGNETS.

WHEREVER steel or iron is handled in quantities by means of cranes a magnet will effect economies in time and labor sufficient to pay for itself in from one to six months. This statement is borne out by experience in steel

FIGURE 1. AN ELECTRO-MAGNET FOR HANDLING SMALL ARTICLES

mills, jobbing houses, safe works, etc., and is evident when the methods, chain versus magnet, are compared.

In all cases an electro-magnet is used, suspended from the hook of the carne; direct current at any of the common voltages being employed to energize the magnet. A flexible twin conductor cable is used to convey the current to the magnet and a small switch operated by the crane man is usually the only additional apparatus necessary. The amount of current used is small, being from one to twelve amperes according to the service for which the magnet is designed.

In operation, the magnet is lowered upon the material to be lifted, and the switch closed, thus causing the magnet to attract and hold the material, which may then be hoisted by the crane and transported to the desired point. By simply opening the switch the material is instantly released.

Comparing this method of operation with the common methods of connecting the load to the hook of the crane with chains, hooks or clamps, the saving in both labor and time is apparent, as, in general, the attachment of the magnet to the load, as well as the release of the load, may be accomplished by the crane operator without assistance, thus saving the labor of one or more men for prying up the material, attaching hooks and chains at the point of loading and additional men at the point of delivery for unhooking the load from the crane.

Magnets can be so quickly attached to and detached from a load that by their use the work which may be done by a given crane is greatly increased, in some cases more than doubled. It frequently occurs that the attachment of lifting magnets to existing cranes so increases their capacity for handling material that the purchase of additional cranes for handling an increased output is rendered unnecessary.

Again, lifting magnets require much less head-room than hooks or chains for lifting material of considerable width, such as plates. Therefore, by the use of magnets, material can be conveniently piled to a greater height in the storage space under a given crane than is possible when chains are used, thus increasing the capacity of a given storage space without altering the crane runway or increasing the size of the building.

Lifting magnets may be used to great advantage in handling pig iron, scrap, rivets, bolts and similar articles in bulk as shown in Figures 1. Ingots, bloom, slabs, billets, bars, plates, rails, structural shapes, pipe, etc., may also be handled to advantage, Figures 2 and 3 being examples.

The Illinois Steel Company use fourteen magnets in their South Chicago works alone, and have found the economy in time and labor so substantial that they have decided to use them wherever possible in all their works.

A single design of magnet is not adapted to handling the full range of material above mentioned; on the contrary the magnet must in every case be designed to meet the form of material to be handled. For instance, there is a wide difference in the design of a magnet for lifting ingots or blooms and one adapted to the handling of thin plates. A magnet which would handle five tons in the form of an ingot might not handle five hundred pounds in the form of thin plates. It is therefore necessary to understand in each case the operating conditions with special reference to the form and range of material to be handled.

The question of risk of accident arises. The Electric Controller and Supply Company, Cleveland, Ohio, report that in its experience with scores of lifting magnets in successful operation it has yet to learn of a single accident which has occurred through their use; while, on the other hand, accidents due to the slipping and breaking of hooks and chains are known to be of very frequent occurrence.

Magnets are always built and tested to from four to five times the specified load, and in addition to a wide practical experience

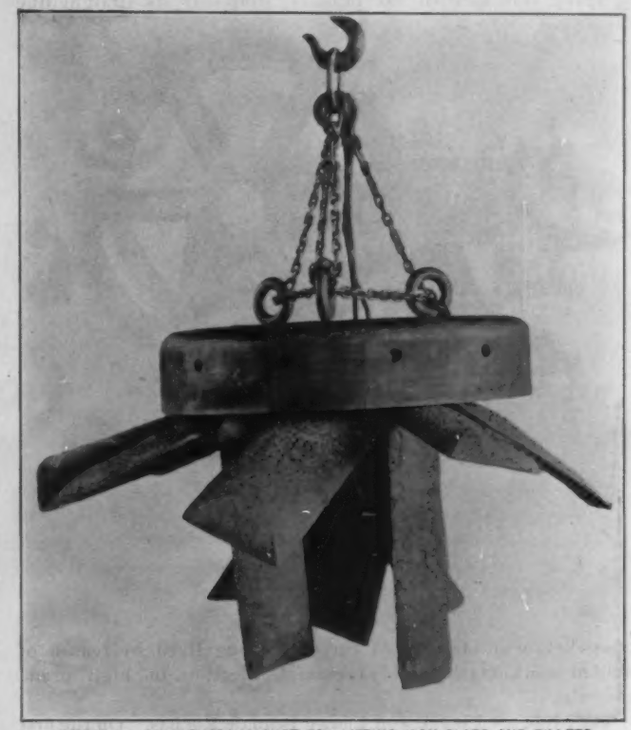


FIGURE 2. AN ELECTRO-MAGNET FOR LIFTING IRON SLABS AND BILLETS

in the application of lifting magnets, the Electric Controller and Supply Company, has at its disposal most complete and valuable data secured through the testing of some forty designs of

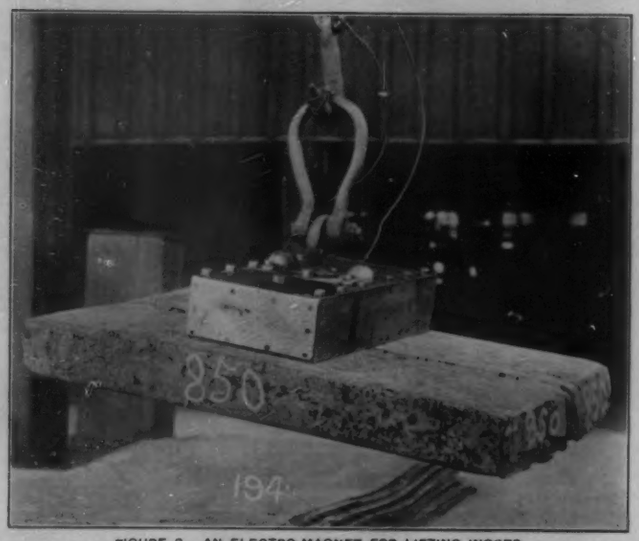
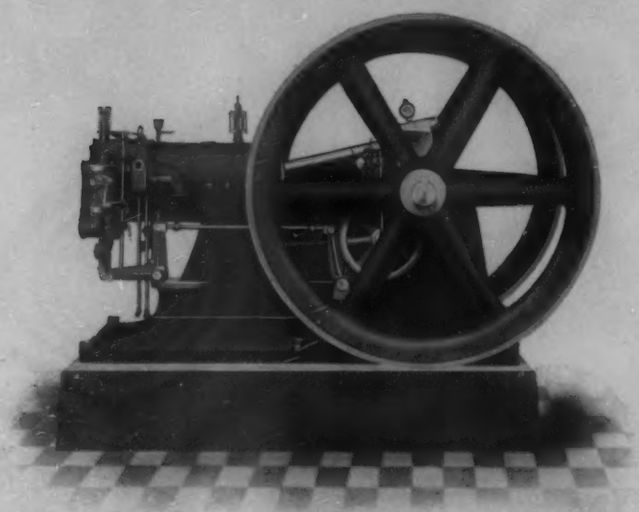


FIGURE 3. AN ELECTRO-MAGNET FOR LIFTING INGOTS

magnets on a testing machine which they have constructed for this special purpose. Their designs are protected by the well known Wellman, Clark and Peik patents.

THE MOORE OIL ENGINE.

IN bringing out the Moore Oil Engine, Messrs. Chas. C. Moore & Co., Engineers, Inc., its builders, have borne in mind the great demand which exists for an engine especially designed for the use of light crude oils, heavy distillates and kerosene in connection with a crude oil system, and which is operative with equal economy on gas, when fitted with a special gas mixing attachment, or with gasoline or light distillate when provided with a vaporizer. As a result they have developed an engine that is heavy, slow speeded, exceptionally simple in its straight line



THE MOORE OIL ENGINE

construction and fewness of parts, and long lived by reason of skilled workmanship and a careful selection of high grade material.

The cycle used is the well known Beau de Rochas. On the first outward stroke of the piston a mixture of oil vapor or gas and air is drawn into the cylinder; on the return stroke the charge is compressed into the clearance space and at the proper time fired by an electric spark, the consequent explosion driving the piston forward and exhausting the burnt products on the next or exhaust stroke.

The Moore oil engine is built in the horizontal type from three horsepower upward.

In the accompanying illustration the Moore Oil Engine is shown, and contrary to the usual custom for the several types and sizes there will be furnished complete specifications on application by any intending purchaser. This departure from the practice of gas engine manufacturers is made with the belief, first, that the proportions are generous and the design, though extremely simple, is yet beyond serious criticism; and, second, that the purchaser is rightfully entitled to a knowledge of what the manufacturer agrees to supply, even to the extent of a careful statement relative to small details. This at once renders a misunderstanding on these points improbable, while affording the purchaser absolute protection in the delivery of full weight and quality as specified.

SAN FRANCISCO-BUILT ELEVATORS FAVORED.

A NOTICEABLE step in the advance of Pacific Coast manufacturers is marked by the award to the Bryan Elevator Company, of San Francisco, of the elevator equipment for two of the most important structures to be erected in San Francisco this year, namely, that for the Townsend Company's Buildings to be occupied by the Pacific Hardware and Steel Company at 7th and Townsend Streets, and that for the new Monadnock Building, owned by Herbert E. Law, on Market Street, adjoining the Palace Hotel.

The equipment for the Townsend Company's Building is unique in several particnlars as regards the installation of electric elevators on this Coast, in that all of the electric engines are to be placed over the hatchways instead of in the basement, as is usual. This equipment comprises one electric passenger elevator and five heavy electric freight elevators, together with four heavy hydraulic machines, each equipped with its own separate pump and tanks, the pumps being driven electrically.

In the Monadnock Building the equipment will comprise five high speed electric passenger elevators, traveling at a speed of 400 feet per minute with loads of 2000 pounds. One of these elevators will be arranged also for lifting safes or heavy furniture up to 6000 pounds weight. The balance of this equipment comprises an electric freight elevator and two sidewalk lifts.

The importance of the ten story Monadnock Building, which, when completed will be one of the most striking and imposing structures in the city, and being situated, as it is, in the heart of the business and financial district, is an evidence of the position which the Bryan Elevator Company is taking in Pacific Coast industries.

This company, while in existence but a comparatively short time, has executed in the most creditable manner some of the best elevator work to be found on the Coast. A departure from establishing elevator practice, and one which is in line with the best work in the electric industry, is the use of oil break switches on electric elevator machines, which thus eliminates the flashing and burning of contacts so noticeable in electric elevators in the past.

The system of control also developed by the Bryan Company is one which enables their elevators to be handled in stopping and starting with an unusual degree of ease and smoothness, and places their machines in the first rank of elevator work.

The Bryan Elevator Company is also manufacturing a complete line of hydraulic elevators and belted machines, and with its well appointed works on Folsom Street is likely to become an important factor in the manufacturing industry in San Francisco and on the Coast.

A new line of single-phase induction motors is described in Bulletin No. 142, of the Stanley Electric Manufacturing Company.

A NEW LINE OF POLYPHASE GENERATORS.

ONE of the newest of the electrical manufacturing concerns to develop a complete line of alternating current electrical apparatus is the Electric Machinery Company, of Minneapolis, which is energetically soliciting Pacific Coast patronage through its Western agency, the Standard Electrical Construction Company, Rialto Building, San Francisco.

In order that the type of polyphase apparatus built by the Electric Machinery Company, may be comprehended, it is fitting to illustrate herewith a 250-kilowatt three-phase generator of its production, and to give a general specification which has prevailed in its manufacture:

Under a power factor of 100 per cent. and when carrying a full ampere load with full voltage for ten hours the temperature of the windings rise not to exceed 25 degrees centigrade with the surrounding air at twenty-five degrees centigrade; under 25 per cent. overload the temperature rises to not exceeding forty degrees centigrade in three hours, and under 50 per cent. overload the rise is not to exceed 45 per cent. centigrade in two hours as indicated by the thermometer. As to efficiency, that under full non-inductive load is 92 per cent., under three-quarter non-inductive load it is 91 per cent., and under one half non-inductive load it is 88 per cent., the regulation being 7 per cent. for any non-inductive load and 18 per cent. under a load having a power factor of 80 per cent.

WATER WHEEL TYPE ALTERNATING CURRENT GENERATOR BUILT BY THE ELECTRIC MACHINERY COMPANY, MINNEAPOLIS, MINN.

The generator is of the latest design of revolving field apparatus. The high voltage winding is stationary and highly insulated. The revolving part carries the exciting current, the voltage of which never exceeds 125, the current being carried from the exciter through carbon brushes to slip rings on the shaft and thence through rigidly fastened conductors to the revolving field coils. The generator has three bearings, each fitted with ball and socket babbitted bearing sleeves. The pedestals are removable from the bed and caps are removable from the pedestals. The bearing sleeves are split and can be removed from the bearings without raising the shaft more than one thirty-second of an inch.

The armature consists of finely laminated annealed steel sheets, held by clamping rings and bolts in a single cast iron shell in the form of a hollow box ring. This form gives the armature extreme rigidity and prevents sagging or vibration. The armature rests on two surfaced feet, wide apart, and of large area, insuring stability in all directions. The armature coils are laid in open slots, and secured by removable wedges. All coils are of the same shape so the least difficulty is experienced in making repairs. The insulation of the windings is tested by a pressure many times the maximum obtained in operation. The armature core is honeycombed with air spaces, and the revolving field drives a large amount of cool air through these spaces, dissipating the heat generated under load in the core and windings.

The revolving field consists of a cast steel spider, with projecting poles, over which edgewise wound strip copper field coils are slipped. These are secured in place by heavy laminated pole tips, which are securely fastened to the cast projections and air spaces are provided so that air passes freely inside as well as outside of the field windings. The voltage per field coil is never more than eight or ten volts and voltage between turns less than one-tenth of a volt, so a breakdown or burnout of field coil is practically an impossibility.

If an armature coil should be injured by lightning or accident repairs are easily facilitated as follows: The injured coil may be cut out of circuit in a few minutes, and the generator again put in service without it an l run without injury until such time as it may be shut down long enough to replace the injured coil. To give access to the armature the whole armature ring can be slid sidewise on the bed so the armature is entirely cleared by the revolving field. This can be accomplished without disturbing any of the pedestals, slip rings, exciter or anything except to unbolt the ring from the bed. Notches are provided in the bed so that the ring is much more quickly moved with a bar than by slow screw methods.

The workmanship of these machines is of the best throughout, and when completed all cast surfaces are thoroughly filled and rubbed down and painted. Wherever two metal surfaces meet each surface is finished, including all nut and bolt seats. The generator will operate in parallel with other generators successfully where the angular displacement of the generators does not exceed 3 per cent. electrically at the maximum, as caused by variation of angular velocity of the driving power.

The California Engineering and Construction Co., of San Francisco, was awarded the contract for the heating and ventilating system of the new Fairmont Hotel, at their bid of $36,000. The contract includes three "Franklin" boilers of 125 horsepower each.

SOME RECENT PELTON SALES.

THE Pelton Water Wheel Company, of San Francisco and New York, reports a brisk trade in its product, quite a number of sales having been made to power companies operating steam plants, which have found it necessary to supplement their present equipment with Pelton wheels direct connected to generators. On account of cost of maintenance and fuel for the steam plants, the water wheel governors, where the two stations are operating in parallel, are arranged to lag behind the engine governors. In this way, the engines are favored when the load drops off, thus effecting a large saving in fuel. In several instances, the steam plants will be shut down entirely, the entire load being handled by Pelton wheels. The engines, however, will be held in reserve, in case of a shut down at the hydraulic station. Several recent sales referred to are: A 700 horsepower Pelton wheel for the hydraulic plant of The Grande Ronde Electric Company, of Oregon, which will close down the steam and water turbine plant immediately upon the completion of the new hydraulic station. The pressure under which the new wheel will operate is 877 feet. A 450 horsepower Pelton wheel for The Nanaimo Electric Light and Heating Company, of British Columbia. This water wheel belts to a line shaft, now driven by steam engine; the latter will be used to help out the Pelton wheel at periods of low water and at peak load. The Silver Lake Mines of Colorado, have ordered a 600 horsepower Pelton wheel to be direct coupled to a 400 horsepower Allis engine. The two prime movers will drive generators in the large power plant of this Mining Company. A 450 Pelton wheel unit is also under course of construction for the Territorial Government of Hawaii, besides a 900 horsepower unit for La Grande Water Storage Company of Oregon. Pelton combination needle and deflecting nozzles are used in the above plants, the deflecting portions being handled by Sturgess and Lombard Governors.

A DINNER OF THE PARAFFINE PAINT COMPANY.

THE annual dinner given by the Paraffine Paint Company to its traveling men was held on Friday evening, December 30th, in the banquet room of the Merchants' Club, in San Francisco. This is the fourth annual dinner given by this company for the purpose of bringing together the factory superintendents and the company's salesmen. The company has resident agents established in various cities on the coast, the territory adjacent to these cities being covered out of central offices. Thirty representives from different parts of the West were seated at the table. A pleasant evening was spent about a bounteous board. The utmost goodfellowship prevailed, and the gathering will no doubt prove a source of great benefit to the men and the company.

The Paraffine Paint Company is now in its twenty-first year. It has shown a remarkable growth, and in its goods, P. & B. Ready Roofings, P. & B. Building Papers, P. & B. and Pabco Paints and Malthoid Roofings, are very thoroughly known all over the West and in foreign countries adjacent to the Pacific Ocean. Its success, while largely due to the excellent quality of the goods manufactured, is also due to the intelligent and energetic way in which these goods have been brought to the attention of users. The works of the company are located in the town of Emeryville, Alameda County, Cal., (the railroad station being known as Paraffine), while the main offices are at 24 Second Street, San Francisco.

THE STEAM TURBINE IN PUMPING SERVICE.

THE Deane Steam Pump Company, of Holyoke, Mass., is distributing a new catalogue on condensers—No. D-23. This publication reviews the principles and advantages of the several types of condensers as applied to steam engines, including surface and jet condensers, and discusses, also, vacuum pumps, exhausters, air and circulating pumps, and other auxiliaries. A recent development, which is treated of quite fully, is the provision of proper condensing arrangements for steam turbines. Unlike the reciprocating engine, the turbine can expand its steam to the extreme limit of the exhaust pressure and every inch of vacuum above twenty-six inches increases the economy by from 3 to 5 per cent. It is therefore advantageous to use the most perfect type of condensing equipment for this service, which has led to the production of improved types of independent air and hot-well pumps, seperate circulating pumps, air coolers, etc. Everyone having to do with steam power plants will find this book of value.

METAL ANALYSES IN SAN FRANCISCO.

ANNOUNCEMENT has just been made that Smith, Emery & Co., chemical engineers, San Francisco, will henceforth represent the Pittsburgh Testing Laboratory (Lt'd), inspecting and metallurgical engineers, of Pittsburgh, Pa., in the Pacific Coast States. Hereafter orders for the inspection of bridges, cars, locomotives, building materials, etc., at rolling mills and shops in the East and Middle West can be filed with Smith, Emery & Co., and local Pacific States inspection work, physical testing and metal analyses as well, will be done by the resident engineers and chemists of the firm named. The fact that this important inspection bureau has found it necessary to make definite connections on the Pacific Coast is another evidence of the rapidly growing importance of the trade in construction iron and steel, railroad and steamship supplies and metal industries in this section of the world.

A NEW BRANCH HOUSE OPENED.

THE National Conduit and Cable Company, with main offices at 41 Park Row, New York, has opened a branch store in San Francisco at 146-156 Second Street, San Francisco. The company has over 12,000 feet of floor space in the store room and basement where it is putting in a complete stock of bare copper wire and cable, paper insulated cables, fire and water proof wire and cable, for high and low tension work. W. S. Eckert, special agent of the company, is locating the branch and will continue here until spring when a permanent manager will be placed in charge.

NEW INCORPORATIONS.

SAN FRANCISCO, CAL.—North Side Water Company; capital stock, $50,000; subscribed, $500. Incorporators John Richard, W. D. Bent, George Manuel, L. Sinclair and J. E. Manning.

SANTA ROSA, CAL.—The Western Redwood Company has been incorporated by A. B. Davis, C. Webb Howard and J. M. Duke. The company will establish an electric plant at its works and will build an electric railway.

TUCSON, ARIZ.—The Bourbon Gold Mining and Electric Power Company; capial stock, $500,000. Incorporators, W. E. Howell, H. J. Pollard, Walter N. Brunt, *et al.*, with place of business at Tucson and offices in San Francisco.

INDIO, CAL.—The Indio Water, Light and Ice Company has incorporated to manufacture electric light and gas, developing water and manufacturing liquid air, ice, etc. The directors are W. F. Everett, H. Kuhl, H. E. Tallant, Marshall Lewis, *et al.* Capital stock, $30,000

SAN FRANCISCO, CAL.—Jamestown and Yosemite Railroad Company; capital stock, $1,000,000; shares, $100 each; subscribed, $75,000. Incorporators T. S. Bullock, 450 shares; S. D. Freshman, 297; S. H. Smith, C. N. Hamblin and W. C. Potts, one share each; place of business, San Francisco.

SAN FRANCISCO, CAL.—The Stut Oil Gas Manufacturing Company has been incorporated to build gas works under the Stut patents. Mr. Stut is engineer of the San Francisco Coke and Gas Company. Incorporators J. C. H. Stut, Leopold Michels, Charles G. Lyman, *et al.* Capital stock, $450,000.

MODESTO, CAL.—Newman Light and Power Company, capital stock $20,000, subscribed in full. Incorporators, Mrs. Annie McDonald, of San Francisco, Joseph McDonald, of Napa City, J. S. McDonald, of San Francisco, J. G. McDonald, of Newman, An-

drew McDonald, of Newman, and Charlotte McDonald of San Francisco. The plant is in operation.

TRANSMISSION.

RENO, NEV.—The Washoe Power and Development Company will establish another substation in Reno.

POMONA, CAL.—Mr. Adamson is endeavoring to interest business men in the construction of an electric power plant.

VISALIA, CAL.—Arrangements are being made by the Mt. Whitney Power Company to extend its line into the Alta district. B. M. Maddox is the manager.

SPOKANE, WASH.—Fred B. Grinnell has secured water rights at Nine Mile Bridge which he has offered to the Spokane and Cœur d'Alene Traction Company.

WINTERS, CAL.—E. D. N. Lehe has applied to the Board of Trustees for a franchise to erecct poles, wires, transformers, etc., along the streets of Winters.

NORTH YAKIMA, WASH.—The Northwest Power and Light Company, of which Robert E. Strahorn is president, will establish a power and lighting plant in this city.

MANILA, P. I.—The Commissioners have passed an act granting to Ignacio Arnalot the authority to use the Albay River for the purpose of generating light and power.

HONOLULU, T. H.—Harry Jaeger is reported to be interested in the formation of the Kenai Electric Power Company, which will establish a plant at the foot of the Garden Island.

BUTTE, MONT.—R. J. Briggs, of Idaho Falls, is in Butte negotiating for machinery for the construction of a power plant at Idaho Falls for the Idaho Power and Transportation Company.

SEATTLE, WASH.—It is reported that arrangements have been made whereby the Seattle Electric Company will buy out the Ballard Electric Company, with the exception of the pumping plant.

SPOKANE, WASH.—M. T. Thierman, John A. Week and J. E. Peterson have filed on water rights on the Spokane River, near Trent. It is their intention to build a sawmill and put in a power plant.

SEATTLE, WASH.—The *Prospector* states that John Boyd has ordered machinery and will install an electric plant to furnish 750 horsepower for the Palmer Mountain Tunnel Company at Loomis.

PRESCOTT, ARIZ.—The Jessie Mines Company, owning claims in the Big Bug District, propose to obtain power, water and light from the Agua Fria River, the plant for which is estimated to cost $300,000.

SANTA CRUZ, CAL.—The Big Creek Power Company will erect a building to be used for offices and as a transformer station. The company is largely increasing its distribution system throughout the town.

BAKERSFIELD, CAL.—The recently completed plant of the Kern River Power Company has been put in operation. The company is controlled by the Pacific Light and Power Company, of Los Angeles.

LA GRANDE, OR.—The Grand Ronde Electric Power Company is arranging to build a power house at the Cove to furnish more power for La Grande and give lights to Union, Hot Lake and the Cove. Machinery has been ordered.

LOVELOCK, NEV.—Contracts have been let for the erection of poles and the installation of a power plant for the Owens River Power Company to convey power into Tonopah and Goldfields from the Owens River, Inyo County, Cal.

BOISE, IDAHO.—The Barber Lumber Company has awarded the contract for a 1500-kilowatt plant to be driven by water wheels. The plant will be used for power, lighting and possibly for an electric railway. It will be completed in June.

STOCKTON, CAL.—The Supervisors have granted a franchise to William Angus to erect and maintain wires, etc., for transmitting and conducting electric current over and across public highways, roads, etc., in the streets of San Joaquin County.

MODESTO, CAL.—The Stanislaus Power and Milling Company is putting in a line to Copperopolis, some miles beyond Knights Ferry, in Calaveras County, to supply from 300 to 400 horsepower to a company opening the old copper mine there.

PORTLAND, OR.—President Goode of the Portland General Electric Company states that his company has decided to build a 40,000 horsepower electric plant at Oregon City, work on which will be commenced during the low water period of 1905

SPOKANE, WASH.—The Two Rivers Townsite and Investment Company is putting in a large power plant on the Snake River, five miles from the Columbia, with which it is intended to run irrigation pumps for irrigating about 15,000 acres of land.

MARYSVILLE, CAL.—Thomas J. Meade, an employee of the Bay Counties Power Gompany, was killed at the Colgate power house on December 18th by coming in contact, it is stated, with a 30,000-volt wire that had broken away from its insulators.

BAKER CITY, OR.—The plant of the Rock Creek Power Company has been placed in operation again. A decision favorable to the use of the water from Rock Creek by the company has been given at Washington. Colonel W. F. Butcher is interested in the company.

STEAMBOAT SPRINGS, NEV.—The J. W. Hopkins Company is now figuring on a complete electric plant for the development of the Great Western Mines at Steamboat Springs and for the lighting of the large hotel which the company intends to erect there in a short time.

HERMOSILLO, SONORA, MEX.—The erection of a 100 stamp mill at Cerro Prieto, this State, is assured and construction will soon begin. An extensive power plant will be built at Maddalena and electric power will be transmitted by wire to the mill at Cerro Prieto, thirty-five miles distant.

COLUSA, CAL.—Work has been started on the construction of the power plant on Butte Creek for the Northern Electric Railway and Navigation Company, in which W. T. Forsman is interested. E. W. Sutcliff will supervise the construction of the plant, which is designed to develop 2000 horsepower.

SALT LAKE, UTAH.—The Board of Directors of the Utah Light and Railway Company have appropriated $250,000 for the extension of the steam plant on the Jordan River that will eventually generate 10,000 horsepower. They also appropriated $250,000 for the improvement and extension of the street railway system.

MONTERREY, MEX.—It is reported on good authority that the Conchos River Power Company is preparing for the erection of an immense electric power plant on the Conchos River near La Joya, at a cost of $1,000,000 gold. The power will be transmitted to Parral and also to Chihuahua and the mines along the route.

IMPERIAL, CAL.—The ice and light plants of the Imperial Light, Water and Power Company have been sold to W. F. Holt. The water plant will be retained by the company. Mr. Holt will operate the present plant until the completion of the 2000 horsepower system at Holtville, which will be in three or four months.

SACRAMENTO, CAL.—The South Yuba Water Company and the Central California Electric Company have been absorbed by the California Gas and Electric Corporation. The South Yuba supplies power and electric lights to Sacramento, Roseville, Rocklin, Loomis, Penryn, Newcastle, Auburn, Colfax, Dutch Flat, Towle and Grass Valley besides a number of mines and logging camps.

BISHOP, CAL.—The Nevada Power, Mining and Milling Company, 302 Boston Building, Denver, Col., is establishing a power plant near Bishop, Inyo county, Cal., to transmit power to Gold-

field and Tonopah. C. M. Hobbs, general manager of the company is in the field. Three thousand to 5,000 horsepower will be developed.

HAINES, OR.—There are prospects for the establishment of an electric power plant on Rock Creek, west of Haines. Bids for the construction of two reservoirs are being called for, work to be commenced by June 1st, and completed by September 1st. Eilert Eilertson, of Haines, and Senator Walter M. Pierce, of Pendleton, are the parties interested.

SPOKANE, WASH.—E. P. Wheeler, manager of the Mineral Hill Mine, at Conconully, states that the plans of the company include the installation of an electric plant on Salmon Creek from which 4000 or 5000 horsepower can be developed to furnish power for the mine, light for the county seat and power for an electric railway to be built from Conconully to Alma.

REDDING, CAL.—The machinery at the Mida Mine at Harrison Gulch is to be run by electricity by the company's own plant. As a preliminary to the installation of this power Vice-President L. A. McIntosh *et al.* have amended notice of appropriation of 4000 inches of water to be taken from Begum Creek in the extreme northwest portion of Tehama County.

ALBUQUERQUE, N. M.—The Capital Light and Power Company, interested in which is W. H. Greer, president of the Albuquerque Traction Company, is preparing to carry through its project to establish a power plant on the Upper Pecos River, about fourteen miles east of Albuquerque. It is planned to furnish light and power to Santa Fe, Las Vegas, and Albuquerque.

CITY OF MEXICO, MEX.—A party composed of William McKenzie, of San Antonia, Tex., Major George S. Burbank and George Stuart Simons, of New York, and A. S. Harvey, of Leadville, Col., is at present in the city for the purpose of inaugurating, if plans now forming mature, a scheme for generating electrical power from waterfalls situated within seventy kilometers from the city.

CITY OF MEXICO, MEX.—The Mexican Light and Power Company propose to transmit electrical power to the district of Tamascaltepec, Zacualpam, Sultepec, Taxco and Malinaltenango. W. A. Ferguson, electrical engineer of the company, has gone to that section to make final surveys for the erection of transmission lines. The transmission line from Mexico to El Oro is now well under way.

WALLA WALLA, WASH.—A deed has been filed conveying all the real property, including power plants, electrical lines and twenty-four deeds of right of way of the Washington and Oregon Power Company to the Northwestern Gas and Electric Company. The deed is signed by Isaac Anderson, as president, and Robert E. Allen, as secretary, of the Washington and Oregon Power Company.

VANCOUVER, B. C.—Hydraulic operations on a large scale will be conducted next year by W. Lawrence Brooze, of New York, on his claims on Bullion Creek. He will spend the winter in the city making arrangements. He intends to install a $300,000 dredge, an electric plant to run by water power and the best modern appliances for the recovery of gold. A flume 600 feet long will be constructed.

SONORA, CAL.—R. W. Hersey of San Jose, has transferred to the National Park Electric Power Company, of San Jose, water rights of 50,000 inches located by G. J. Kuhn, also an agreement from Louis Cassanetto for 70,000 inches of water rights in Cherry River, 50,000 inches of water rights located in the main Tuolumne River, and 45,000 inches of water rights located by G. W. Wakefield.

PROSSER, WASH.—If control of the water in the river at Prosser can be secured, President E. F. Benson, of the Prosser Falls Land and Power Company, insures that he will construct a fourteen-foot dam on the present structure, making the stream navigable to the west end of Snipe's Mountain, at a cost of $40,000. Mr. Benson also contemplates a power plant to furnish electricity for lighting, manufacturing and all purposes.

PRESCOTT, ARIZ.—Samuel C. Symonds, representing the Verde Water and Power Company, is securing estimates of the probable amount of electric power that can be disposed of to mining companies of this county. The location of the proposed reservoir for irrigation purposes is on the Verde River. It is proposed to carry the water below the site of the reservoir and dam and turn it over a 300-foot precipice for generating electricity.

MISSOULA, MONT.—Senator W. A. Clark has bought land near Bonner from John McCormick for $20,000 for electrical purposes. The purchase carries water rights and power location. Work will begin within thirty days on a dam across the Missoula River. It is planned to build a trolley line between Missoula and Bonner and through the city. The line will extend to Fort Missoula immediately and later will traverse the Bitter Root Valley.

ANACONDA, MONT.—Major John McCormick states that within thirty days an engineer will be here to begin preliminary work of construction on the dam and electric plant on the property recently sold by him to W. A. Clark, near Bonner. The dam will be of wood and the power plant will be modern in every detail. A survey for an electric road to extend from Bonner through Missoula to Fort Missoula will be made at the same time.

CHIHUAHUA, MEX.—A party composed of W. B. and J. H. Deveraux, C. S. McHenry, of Cananea, and L. N. Askit, of Brigham, Utah, has been in the mountains recently for W. C. Green looking over the possibilities of putting an immense electric plant on the Aros River to run the planing and sawmills and smelter to be established at Dedrich, the junction of the Rio Chico and Aros rivers, and also the Mulatos mines in Sonora.

BRIGHT ANGEL, ARIZ.—The United Gold and Platinum Company, which has claims on the rim of Cataract Canyon, in the Grand Canyon neighborhood, has located for power purposes the falls of Cataract Creek, and proposes to secure from them electricity for developing power for a railway line into the canyon from a connection with the Grand Canyon line of the Santa Fe Company. H. J. Beemer of New York is interested in the enterprise.

HOLLISTER, CAL.—J. P. Cronk and George T. Drinkwater have taken an option on the purchase of the plants of the Hollister Light and Power Company and the Hollister Water Company. The price named for the former is reported to be $35,000 and for the latter $95,000. If the purchase goes through both plants are to be greatly improved, and it is highly probable that the electric current will be produced by water power in Grass Valley, fourteen miles from Hollister.

WILLIAMS, ARIZ.—The United Gold Platinum Mines Company, in which H. J. Beemer, of New York City, is largely interested, propose to perfect its water right in the Cataract Canyon and place the initial foundation for an electric plant. In the early spring operations will begin toward the completion of the heavy grade into the canyon, and construction of an electrical line from Grand Canyon to that point. Upon the installation of the power plant the railroad will be operated by electricity, also the reduction plant.

SAN JOSE, CAL.—The National Park Electric Power Company, with a capital stock of $250,000, composed of J. J. Inman, M. E. Page, W. H. Baugh, G. P. Bull and J. H. Rucker, and the Santa Santa Clara Interurban Railroad Company, with a capital stock of $5,000,000, composed of J. C. Campbell and W. L. Metson, of Santa Clara, J. F. Parkinson and F. D. Dorman, of Palo Alto, and E. M. Rea, of San Jose, are carrying through plans for the location of a power house and the operation of an electric street railway line previously mentioned.

CITY OF MEXICO, MEX.—The work of canalization of the waters of Tequisquiapam which are to be utilized for motive power and light for the city of Queretaro are being rapidly finished by the company holding the concessions from the Department of Fomento and the Queretaro State Executive. Governor Francisco Gonzalez Cosio will visit the installation about the end of the month. The engineer in charge of the work, Juan B. Alcocer,

came to Mexico a few days ago to present to the Secretary of Fomento the plans of the completed work.

SINALOA, MEX.—The Culiacan Electric Company, recently organized to operate an electric light and power plant in the State of Sinaloa, Mexico, is preparing to begin the construction of the plant. A formal organization of the company, composed of San Francisco men, has been effected by the election of I. Gutte as president, F. G. Brane, secretary and treasurer; H. Hacke and Henry Eichoff, directors, and Sidney Sprout, manager and engineer. The company was organized with $200,000 capital stock. In addition to the lighting and power franchise, the company has secured franchises for telephones and a street railway.

CITY OF MEXICO, MEX.—Major George B. Burbank and George Stuart Simons of New York, are in Mexico in connection with a project to utilize Malinaltenango Falls for power purposes. The possibilities of which were put before Eastern capitalists, represented by the above named gentlemen, by William McKenzie of San Antonia, Texas. The falls are in the Tenancingo district of the State of Mexico, about forty-five miles southwest of this city. The volume of water is small, but it drops a distance of 2740 feet, and it is estimated that 25,000 horsepower can be generated. It is proposed to supply power to surrounding mining camps, and transmit it to this city for manufacturing purposes.

WALLA WALLA, WASH.—Through a reporter's error a misstatement was made in these columns last month* concerning the plant of the Washington and Oregon Power Company which accredited the General Electric Company with furnishing the generator and transformers used. This apparatus was built by the Bullock Electric Manufacturing Company and installed through its Pacific Coast representatives, the Wagner-Bullock Electric Company, of California. Furthermore, the line is being operated at a potential of 43,000 volts—not 23,000 volts, as stated—which is delivered from 25,000-volt Bullock transformers in star connection.

SAN FRANCISCO, CAL.—The California Gas and Electric Corporation has ordered from the Stanley Electric Manufacturing Company two mammoth frequency changing outfits of 5000 kilowatts each, amounting to virtually 20,000 kilowatts capacity divided between four machines operated as two motor-generator sets. These outfits are for use in connection with the contract which the corporation has secured from the United Railroads of San Francisco, and will change the sixty-cycle current from the Bay Counties line to twenty-five cycles for further distribution among the substations of the street railway company. The contract awarded the Stanley Company also includes transformers of 12,000 kilowatts.

TRANSPORTATION.

STOCKTON, CAL.—The Stockton Electric Railroad Company will extend its system in this city.

SAN BERNARDINO, CAL.—It is probable that the San Bernardino Traction Company will extend its line to Rialto.

SAN DIEGO, CAL.—The right of way has been granted to E. S. Babcock for his electric road over tide lands.

MARTINEZ, CAL.—A franchise has been granted for the construction of an electric road as applied for by R. H. Latimer.

SUISUN, CAL.—J. W. Hartzell and associates are having surveys made for their proposed line to Fairfield, Dixon and Woodland.

LAS VEGAS, N. M.—The Las Vegas electric line is to be improved. Don Margarito Romero, is vice-president of the company.

POMONA, CAL.—The Pacific Electric Railway will begin the construction of its branch line to Covina and thence to Pomona next April.

BAKER CITY, OR.—W. L. Vinson and associates are pressing the preliminary work on an electric railway from this city to Eagle Valley.

*THE JOURNAL, Volumn XV, page 32, January, 1905.

LINCOLN, CAL.—Arrangements for the construction of a steam railway from this place to Grass Valley are being made by C. L. Wilson of Lincoln.

SONOMA, CAL.—Solomon Schocken and Oscar T. Weber *et al.*, will receive a hearing February 1st on the application for an electric railway franchise.

HAZEN, NEV.—An organization of Hazen, Fallon and Reno capatilists is being formed at this place to build an interurban line from Hazen to Fallon.

BENICIA, CAL.—F. A. Brand, of the Benicia Iron Works, has petitioned the Board of Trustees for a franchise to build and operate an electric railway in this town.

LOS ANGELES, CAL.—The Council has received the petition of J. H. McCarthy for a street railway franchise to began at the intersection of First and Indiana streets.

EUGENE, OR.—The Willamette Valley Electric Railway Company will build its power house at Martins Rapids on the McKenzie River. H. C. Diers chief engineer.

PHOENIX, ARIZ.—The Poland Mining Company, which has constructed a tunnel between the town of Poland and Walker, have plans for installing an electric line.

IMPERIAL, CAL.—W. F. Holt and Lacy Holt, who are building up the Imperial Valley, intend to connect the towns of the Valley by a thoroughly up-to-date system of electric railways.

OAKLAND, CAL.—The Oakland Traction Company, which has succeeded the Oakland Transit Company, has decided to increase its bonded indebtedness by $2,174,000 for improvements.

POINT RICHMOND, CAL.—The East Shore and Suburban Railway will construct a power house, car barn and depot on property recently acquired east of the Southern Pacific's Macdonald Avenue depot.

FORESTVILLE, CAL.—A bonus of $3000 has been raised for the extension of the electric railroad from Green Valley. The survey for the line was made under the direction of Engineer H. A. Kleugel.

MISSOULA, MONT.—The Amador Gold and Copper Milling and Mining Company is building a power house and constructing an electric railway from Amador to Oregon Gulch, where its mines are located.

SPOKANE, WASH.—The Farmers Grain and Supply Company, of Spokane and Cheney, have organized a company, with $200,000 capital, to build an electric road from Connell to Fletcher, thirty-five miles.

PETALUMA, CAL.—It is reported that at an early date ground would be broken for an electric railroad from Petaluma to McNear's Point at Point Pedro. The McNears, of Petaluma, and others are interested.

SAN JOSE, CAL.—The Santa Jose and Los Gatos Interurban Railway Company has petitioned the Board of Supervisors for five franchises for electric roads in San Jose and the eastern portion of Santa Clara County.

CARLSBAD, N. M.—The Carlsbad Consolidated Oil Company, formed by leading Los Angeles citizens, have arranged for a railroad to the Gyp Creek district and engineers are now surveying the line to the new town of Oil City.

LOS ANGELES CAL.—The Pacific Electric Railway Company has begun the construction of an air line from Los Angeles to Alamitos Bay by way of the Willows. A double track of heavy rails is to be built direct to the Bay.

SAN JOSE, CAL.—W. A. Beasly, representing the Interurban Railroad Company presented a petition for a franchise to build a single track, broadguage electric railroad from the corner of Market and San Fernando to Third Street.

PORTLAND, OR.—The Oregon Traction Company is actively engaged in the construction of its line to Hillsboro, Cornelius and Forest Grove. Andrew Graydon is president of the company, which has organized with $1,250,000 capital.

HONOLULU, T. H.—The McBryde Sugar Plantation is negotiation a deal for bonds for the installation of its electrical system. It is almost assured that the Hawaiian Electric Company will have charge of the installation of the electric plant.

MISSOULA, MONT.—Senator W. A. Clark is behind a project to establish a power plant and build an electric railway from Bouner, through Missoula to Fort Missoula. Rights of way have been secured by W. M. Bickford and J. R. Wharton of Butte.

EUREKA, CAL.—Messrs. Green and O'Brien of San Francisco, contemplate building an electric street car line in Eureka, and suburban roads to Arcata and Ferndale. The petition will come before the Council at the next meeting of that body on February 17th.

CLARKSTON, WASH.—The Clarkston and Pomeroy Electrical Railway Company has been organized by Wm. McCarroll, V. D. Norman, A. S. Burnett, Mayor Frank E. Brown, W. O. Bond, Peter Briggle and E. H. Cooper to build a line from Clarkston to Pomeroy.

SAN LUIS OBISPO, CAL.—F. S. Granger of Santa Cruz has made a proposition to build an electric railway to Avila Beach at the Port Harford Government Breakwater, ten miles from this city. He proposes to put in a railway costing $25,000 per mile and asked a bonus of $50,000.

GUADALAJARA, MEX.—The government of the state has granted a concession for the construction of electric tramways in the City of Guadalajara and to some of its suburbs. The main shareholders of the company organized to do the work is Senator Ramon Alcazar of Mexico City.

SANTA BARBARA, CAL.—The Interurban Railway Company has been organized to operate an electric railway to Summerland, Carpenteria, Ventura, and eventually to reach Los Angeles. The capital is $250,000. John B. Miller, F. E. Miller and A. L. Selig, of Los Angeles, are the incorporators.

SANTA ANA, CAL.—Construction has been recommended on the Los Angeles-Santa Ana branch of the Pacific Electric Railway near Watt's Station, Long Beach line. It is said that early in the year the three-mile line between Huntington Beach and Newport Beach will be built as an extension of the Long Beach line.

DOUGLAS, ARIZ.—At a meeting of the stockholders of the Douglas Street Railway Company the directors of the company proposed to install an electric street railway covering all the principal thoroughfares of the city and equip it with modern electric cars. The contemplated improvements will cost $40,000.

WILLIAM, ARIZ.—The United Gold Platinum Mines Company in which H. J. Beemer of New York City, is largely interested, propose to perfect their water right in the Cataract Canyon and place the initial foundation for an electric plant. Upon the installation of the power plant an electric railroad will be built.

GLENDIVE, MONT.—At a special meeting of the commissioners of Dawson County, franchises was granted H. J. Haskoll, B. S. Adams, J. J. O'Brien, J. R. Widwyer, for the Glendive and Yellowstone Valley Rapid Transit Company, to build an electric railroad and telephone line from Glendive to Buford North Dakota, a distance of thirty miles. Capital $1,000,000.

COLUSA, CAL.—The towns of Colusa, Princetown, Butte City, Chico, Durham, Oroville, Gridley, Biggam, Marysville, Yuba City and Sutter City a distance of about 135 miles, will be connected by an electric railway, the construction of which has been started by the Northern Electric Railway and Navigation Company. Captain W. T. Forsman is heavily interested in the company.

BILLINGHAM BAY, WASH.—At the annual meeting of the shareholders of the Bellingham Bay and British Columbia Railway Company, the following officers and directors were re-elected: H. H. Taylor, president; F. G. Drum, vice-president; D. O. Mills, W. J. Dingee, S. P. Smith, G. W. McEnerney and Bruce Cornwall. John S. Brum was re-elected secretary and treasures.

SANTA FE, N. M.—Articles of incorporation have been filed for the El Paso and Durango Railroad, the promoters being those connected with the Phelps-Dodge Company, and the El Paso Southwestern. The main line will begin at Mastodon in Dona Ana County and extending a distance of 120 miles. S. W. French of Douglas, Ariz., holds all of the stock excepting one share.

LOS ANGELES, CAL.—J. W. Eddy is one of the promoters of the incline railway up to top of Mt. Hollywood, grading the roadbed of the Mt. Hollywood Railway has been started and it is probable that the roadbed will be completed through Griffith Park to the foot of the incline at an early date. Plans include an electric railway to extend from Sunset Boulevard to Los Feliz Avenue and to connect with the Los Angeles Pacific Railroad.

CITY OF MEXICO, MEX.—M. D. Watson and J. R. Bickerdike, Chicago man, interested in the Rosa Amarilla copper mines in the state of Jalisco, have filed application for a concession to construct an electric railway from the mines to the Pacific coast, also to operate a telephone and telegraph system in that section. A telephone line will run from the mines to Manzanillo at once. Power is to be obtained from the Cusalpa and Santa Maria rivers.

SPOKANE, WASH.—The Spokane Power and Transportation Company has elected its officers for this year as follows: James Cleveland, president; John Condron, vice president; Captain John Gray, superintendent and general manager; Jesse M. Fyfe, secretary and treasurer. The directors are: James Cleveland, George S. Richey, John Gray, John Condron, T. P. Reardon, W. Boyd Block and E. U. Engle. The Spokane Power and Transportation Company has plans for the construction of an electric road from this city to Crystal City, in the Big Bend country, and touching the small towns between those places.

SPOKANE, WASH.—Arrangements preliminary to the construction of an electric railway from Spokane to Moscow, Idaho, are being made by the recently incorporated Spokane and Inland Railway Company; capital stock $3,500,000, The promotors are: Jay P. Graves, president of the Spokane Traction Company, F. A. Blackwell, president of the Coeur dAlene and Spokane Railway; A. Coolidge, president of the Traders' National Bank of Spokane and of the Colfax National Bank of Colfax; John Twohy, railroad contractor and part owner of the Old National Bank of Spokane, and F. Lewis Clark, capitalist.

BOISE, IDA.—The San Francisco, Idaho and Montana Railroad Company, which proposes to construct a railroad from San Francisco to Butte, has been formed with headquarters in Boise. The company is organized with a capital stock of $50,000,000. The officers of the company are to be as follows: President, William Peyton Mason, of Minneapolis; vice-president, C. H. Fleming, of Minneapolis; secretary, G. T. Propper, of Boise; treasurer, W. E. Foran, of Boise. The purpose of the company is to build and operate a line of standard gauge steam railway and telegraph line from San Francisco in northeasterly direction through the States of California, Nevada, Oregon, Idaho and Montana to Butte, via Boise, and connecting branch line from Mason to Winnemucca, Nev. The estimated length of the road is 1000 miles.

TELEPHONE AND TELEGRAPH.

PEPPERWOOD, CAL.—The Sunset Telephone Company have obtained a telephone franchise.

SAN DIEGO, Cal.—The United States Government will put in a wireless telegraph station here.

FULLERTON, CAL.—The Sunset Telephone Company is arranging to rebuild its line in Fullerton.

KELSEVVILLE, CAL.—The Big Valley Farmers' Telephone Association will extend its system to Highland Springs.

ALHAMBRA, CAL.—At a meeting of the City Trustees, P. T. Spencer made application for the sale of a telephone franchise.

SANTA MONICA, CAL.—The City Trustees have sold the Home Telephone franchise for Santa Monica to Lewis Blankenhorn for $450.

NAPA, CAL.—The National Oil and Transportation Company has obtained a franchise for a telephone line on the public highways of Napa County.

INDEPENDENCE, OR.—The Independence Company will incorporate with $10,000 capital. J. R. Craven is chairman of the board of directors.

MILL VALLEY, CAL.—The bid of S. B. Cushing for the franchise for the erection of telegraph and telephone poles in certain parts of the valley was accepted.

BRAWLEY, CAL.—C. W. Bigelow, of Redlands, Cal., has been in the valley with a view of running a telephone line into the valley by way of Banning and Coachella.

OREGON CITY, OR.—The Farmers' Telephone Company, of Oregon City, has been organized with a capital of $5000, by F. R. Andrews, F. J. Meyer and L. E. Jones.

HONOLULU, T. H.—A wireless telegraph system is to be established in the South Sea Islands. J. T. Arundel, manager of the South Sea Guano Company, is behind the project.

PHOENIX, ARIZ.—A. H. Demrick, an electrical engineer of the reclamation service, is in the city to build the government telegraph line between Phoenix and the Arizona dam.

SALEM, OR.—The Greater Salem Commercial Club are considering the movement for an independent telephone line among the farmers of Marion, Yamhill and Polk counties.

MANILA, P. I.—The Manila Telephone Company has been organized with a capital stock of $500,000. It is estimated that it will cost $90,000 to install an effective system in Manila.

GARDNERVILLE, NEV.—L. R. Ames and Frank Simpson have organized a company in Smith Valley with sufficient capital subscribed to build a telephone from Wellington to Gardnerville.

VERNON, B. C.—The Board of Trade has under consideration a proposal from Geo. Williamson to put in a long distance telephone system connecting Enderby, Armstrong, Vernon and Kelowna.

AMITY, OR.—J. B. Long, of the Amity Mutual Telephone Company, reports that an Independent Mutual Telephone Company has been organized at Belleview and that work on its line commenced at once.

FRESNO, CAL—The application for a franchise for another telephone system has been filed by Frank Morsimer, of the Home Telephone Company, who expects to invest fully $500,000 in its plant and equipment here.

PLEASANT HILL, OR.—The Pleasant Hill Telephone Company, president, W. L. Wheeler; vice-president, Wm. Ellis; secretary, H. H. Ruth; treasurer, L. E. Parker, will construct a line immediately to connect with the Pacific States line at Springfield.

SUNNYSIDE, WASH.—At the annual meeting of the Christian Co-operative Telephone Association the question of extending the line to North Yakima was discussed, and A. C. Webber was appointed to take the matter up with the residents along the proposed line.

GARFIELD, WASH.—At a meeting of stockholders of the various telephone lines centering in Garfield, F. M. Scott, chairman and Herman Curtis, secretary, an aggreement was reached for an association of lines. The association will comprise seven independent lines.

CITY OF MEXICO, MEX.—T. F. Maguire, the new general manager of the Mexican Telephone Company, has been laying plans and getting estimates of cost of material, labor, etc., for laying the underground telephone system, work on which is expected to begin the first of February.

NORTH YAKIMA, WASH.—The Ahtanum Telephone Company has been incorporated with a capital stock of $750 for the purpose of constructing a telephone line to connect with the city system. Trustees, James J. Wiley, S. P. Vivian, H. L. Bergeron, Andrew Chambers and Ernest Woodcock.

TENINO, WASH.—The County Commissioners have granted a permit to the Peoples' Co-operative Telephone Company, of Centralia, for the use of the county roads for a period of forty years between Chehalis and Olympia and between Chehalis and Oakville, to construct and maintain telephone lines.

GAS.

VENTURA, CAL.—The Ventura Gas Company will build a large holder.

EUGENE, OR.—The city may issue bonds for a gas plant to cost $75,000.

ABERDEEN, WASH.—C. E. Burrows is preparing to construct a gas plant here.

OXNARD, CAL.—E. P. Foster has been granted a franchise for a gas plant in this town.

FULLERTON, CAL.—The Orange City Gas Company is figuring on installing a gas plant here.

SANTA ROSA, CAL.—The Santa Rosa Lighting Company is extending its mains to Petaluma.

LOS ANGELES, CAL.—The Los Angeles Gas and Electric Company will extend its mains to Hollywood.

COALINGA, CAL.—F. W. Bray, of Coalinga, has obtained a gas franchise. His electric plant has been completed.

POINT RICHMOND, CAL.—J. B. McKenzie has petitioned for authority to lay gas pipes in the town of Richmond.

MONROVIA, CAL.—Edward T. Off has applied to the Trustees for a franchise to lay gas mains in the city of Monrovia.

SALT LAKE, UTAH.—The United Light and Railway Company will spend about $100,000 in the improvement of its gas works.

ALBUQUERQUE, N. M.—F. H. Kent and associates have been granted a franchise for a gas works in Albuquerque and Bernalillo counties.

SAN DIEGO, Cal.—The United Light and Fuel Company, recently incorporated, has applied for a franchise to put in gas mains and build a gas plant.

ANAHEIM, CAL.—The City Council has sold a gas franchise to L. E. Miller and B. V. Beebe. Work on the plant must be commenced within four months.

LODI, CAL.—A. W. Keyso, of this city, has organized a company to bore wells for natural gas. All the stock necessary for that purpose has been taken.

WALLACE, IDA.—H. W. Armstrong, of Spokane, D. W. Henley, L. G. Shinn, J. H. Van Dorn and Lewis L. Sweet have organized the Wallace Lighting and Heating Company, with a capital of $25,000, to establish a gas plant.

LOS ANGELES, CAL.—The Speer Gas Machine Manufacturing Company, has been organized with a capital stock of $100,000, subscribed in full by A. L. Ellis, of St. Louis, Mo.; J. T. Kiggins, S. C. Leppelman and L. M. Anderson, of Los Angeles, and W W. Taylor, of Taylorville; place of business, Los Angeles.

PALO ALTO, CAL.—The Palo Alto Gas Company has been incorporated, with a capital stock of $200,000, by P. H. Eberhard, E. W. MacSwain, W. D. Hayward, H. J. Quinn and D. O. Druffel. The company will not build a plant at present, but will pipe the town and buy its supply from the United Gas and Electric Company, of San Jose.

SAN FRANCISCO, CAL.—On December 31st, the Supreme Court of the State of California handed down a decision which vests the privelege in cities of the fifth class to fix the rate for gas by ordinance. The action was brought on the part of the residents of Pomona. Since this decision was made the cities of Fresno and San Diego have prepared to introduce such ordinances.

VISALIA, CAL.—Pipe has arrived at Visalia and active work on the construction of the plant of the Consolidated Heat, Light and Power Company will begin in a few days. The plant will consist, primarily, of one crude oil set to have an output of 100,000 feet per day; a 150,000 foot, one lift, holder, air compressor, etc., all of which are being built by the Western Gas Construction Company. High pressure pipes will be installed to Tulare, where it will be distributed at low pressure. The plant will be completed in May.

EL PASO, TEXAS—The transfer of the property of the El Paso Gas, Electric Light and Power Company to the El Paso Gas and

Electric Company has been effected. Officers were elected as follows: President, George F. Goodnow, of the North Shore Gas Company, Waukegan, Ill; vice president and treasurer, C. H. Bosworth, National Bank Examiner, of Chicago; secretary, W. J. Cook, of the Hartwell Coal Company, of Chicago; assistant secretary and treasurer, George D. Flory; general manager, Thomas J. Jones, formerly manager of the Chicago Heights Gas Company; attorneys, Edward Clifford, of Chicago, and Millard Patterson, of El Paso. Improvements involving an expenditure of about fifty thousand dollars have been decided upon and machinery has been ordered.

ILLUMINATION.

EUGENE, OR.—The city may issue bonds for an electric light and gas plant to cost $175,000.

CALISTOGA, CAL.—An electric light plant is to be installed here by H. H. Brown and G. S. Cutler.

PINOLE, CAL.—A new transformer house is being erected by the Pinole Electric Light and Power Company.

NORTHPORT, WASH.—The Northport Smelting and Refining Company will supply power for lighting the town.

IONE, OR.—The Council is considering a small electric light plant in connection with the water works it will build.

CIUDAD, JUAREZ, MEX.—Two hundred thousand dollars will be expended by the city for an electric light plant and other improvements.

OGDEN, UTAH.—Citizens of Huntsville may establish a municipal electric lighting plant, to be located at the mouth of the South Fork.

BRIGHAM CITY, UTAH.—Almon L. Wright appeared on behalf of the citizens of Perry, to arrange with the Council to furnish light for that place.

WILMINGTON, CAL.—A petition is being circulated asking the electric light company to establish a substation in this town and furnish electricity for light.

HUNTINGTON BEACH, CAL.—There is considerable talk among the local business men of installing an electric lighting plant to be run on the co-operative plan.

JACKSONVILLE, OR.—A. E. Reames proposes to establish a substation in this town and supply power and light. The feed line crosses the outskirts of the town.

SUISUN, CAL.—An ordinance was passed granting a franchise to Leonard Prior to construct, maintatn and operate an electric light and power system in Suisun.

ABERDEEN, WASH.—Ninemire & Morgan have applied to the City Council for a franchise to construct and operate an electric light plant for a period of fifteen years.

WESTMINISTER, B. C.—Voting on the electric light and power by laws in the municipality of Langley resulted in an overwhelming majority for the proposed work.

EL PASO, TEX.—The new owners of the El Paso Gas and Electric Company have ordered machinery for a new power house it will build. T. J. Jones is resident engineer.

FORSYTHE, MONT.—The City Council has made a contract with J. E. Edwards to light the town with electricity for a period of twenty years. Eight street lights will be installed.

SEATTLE, WASH.—The City Council will pass an ordinance authorizing the issuance of $250,000 bonds for the enlargement of the municipal lighting system and construction of a distributing system.

GRIDLEY, CAL.—The Gridley Electric Light and Power Company, the sole stockholder of which is R. M. Bisbee, is preparing to build a two story brick transformer and office building on Hazel Street.

SACRAMENTO, CAL.—In the list of the appropriations that the University of California expects to receive from the present session of the Legislature is included an electric power plant for the Lick Observatory.

VENTURA, CAL.—The report of the engineer employed to outline the cost of an electric light plant and water works is considered too high and no definate action toward the building of the plants has been decided upon.

SEATTLE, WASH.—L. V. Brewer has turned over his franchise to the Seattle Electric Company who will run a service line into and make extensions all over the city. They are to furnish 2500 sixteen candlepower lights within sixty days.

SUMAS, WASH.—Mr. Merrit of Seattle, Wash., representing T. H. Warford and William Redaker of Ballard, Wash., have asked for a franchise to operate an electric light and a water plant in the town of Sumas for a period of fifty years.

COLTON, CAL.—The Board of Trustees are contemplating the installation of an electric lighting and power plant at Colton, the intention being to put in a big steam plant, install a dynamo and generate power necessary for the needs of the town.

NORTH YAKIMA, WASH.—The Council has passed an ordinance granting a franchise to the Northwest Light and Water Company to erect and maintain an electric light works within and without the limits of the City of North Yakima. Robert E. Strahorn president of the Company.

REARDAN, WASH.—J. M. McDowell, of Deer Park, has made application for a franchise to establish and operate an electric lighting plant in Reardan. Terms were agreed upon between Mr. McDowell and the Council and an ordinance introduced granting a fifteen year franchise to light the town by electricity.

LAS CRUCES, N. M.—Attorney H. B. Holt, of Las Cruces, states incorporation papers are being prepared for a company which will furnish electric power and light to Las Cruces, as well as power for an ice factory to be located there. B. L. Berkey, of El Paso, Texas, who is in the machinery business in that city is interested.

HOOD RIVER, OR.—At the annual meeting, and directly after being re-elected, manager H. L. Vorse, of The Hood River Electric Light, Power and Water Company, resigned his position and disposed of his stock to W. H. Chipping. The management of the company has been assumed by H. F. Davidson, who is also president.

FOREST GROVE, OR.—The Haines Electric Power Company have taken over the electric power and lighting plant and system of the defunct Forest Grove Canning Company. The new company is composed of E. W. Haines, John Thornburg, C. W. Nothingham, Ralph W. Hoyt, W. B. Haines and J. Frank Watson. The capital is $50,000.

SAN DIEGO, CAL.—The United Light, Fuel and Power Company, recently organized with $500,000 capital stock by John D. Spreckles, of San Francisco, together with W. Clayton, C. T. Hincle, B. M. Warner and Harry L. Titus, is preparing to build an electric light and gas plant in San Diego. The Spreckles interests control the street railway system of this city and Coronado Beach.

PACIFIC GROVE, CAL.—It is the opinion of the board of trade committee and also of the city trustees that bonds should be issued for a sufficient sum to provide for the installation of an electric lighting plant, the construction of waterways and for other purposes. It was decided by the board that they will investigate the cost of construction and report at a mass meeting of the people to be called at some time in the near future.

NINGPO, CHINA,—An electric lighting plant which will supply 4000 lights is shortly to be erected at Ningpo. A company has been floated, half the capital of 100,000 taels being represented by the International Commercial Company, and the other half by Chinese. The building is now in course of erection, and the machinery was furnished by the New York Import and Export Company. The whole work, it is expected, will be completed by March 1, 1905.

UKIAH, CAL.—W. W. Van Arsdale, owner of the Walker Valley ranch will furnish the city of Ukiah with electric power. The waters of South Eel River have been appropriated by Mr. Van Arsdale and associates. A tunnel will be run through the mountain to Potter Valley and the water run through the tnnnel instead of being flumed. The city will agree to pay Van Arsdale $4 per month per horsepower, the power to be delivered at the switchboard in Ukiah. The contract is to run ten years, and ten years more at the option of the town. The plant is to be ready for service by next Septemqer.

WATER WORKS.

IONE, OR.—Bids have been received for the construction of a water works.

COACHELLA, CAL.—Machinery has been ordered for a water works system.

RENO, NEV.—The Local Water Company has started to re-construct its system.

CORVALLIS, OR.—The city is considering the building of a water works system.

SEASIDE, OR.—Bonds in the sum of $12,000 may be issued for a water works system.

COALINGA, CAL.—Judge Kerr is organizing a company to install a water works here.

PROSSER, WASH.—The Prosser Falls Land and Irrigation Company is putting in a new water works.

JUAREZ, MEX.—Engineer R. Escobar, of Juarez has finished plans for the complete water works system for Juarez.

PORTLAND, OR.—J. C. Scott, of the St. John's Water Company, annonnces that the company will enlarge the plant early in the spring.

GLENDIVE, MONT.—A special election carried in favor of issuing bonds in the sum of $50,000 for a water works and sewer system.

VANCOUVER, B. C.—The North Vancouver Council has let a contract for the completion of the water works system to J. C. Williams of this city.

SANTA BARBARA, CAL.—The water commissioners have sold a block of $40,000 water works bonds, the proceeds, to be used in extending the system.

FULLERTON, CAL.—The Anaheim Union Water Company will issue bonds, a portion of the proceeds to be used for a pumping plant to cost $20,000.

TILLAMOOK, OR.—William B. Chase, engineer, in a report to the City Council, estimates the cost of the proposed new water works system at $42,000.

MOUND, CAL.—The Mound Water Company has started work on wells in the river bottom, where they expect to develop a large supply of water.

BAKERSFIELD, CAL.—Searles Mining and Water Company has been incorporated by Andrew Anderson, G. F. Dyer, G. E. Woodburyn *et al.* Capital stock, $500,000.

SAN FRANCISCO, CAL.—The North Side Water Company has been incorporated by J. Richards, D. Bent, *et al.*; capital stock, $50,000; place of business, San Francisco.

TUCSON, ARIZ.—There is a general sentiment in favor of bonding the City of Tucson for one or two hundred thousand dollars for improvements in the water system, etc.

TILLAMOOK, OR.—Morris Bros. & Christensen have taken the $45,000 water bonds of the City of Tillamook. A water system will be put it at once and will be of the gravity type.

WHITTIER, CAL.—A resolution has been adopted by the City Trustees declaring it a public necessity that the city vote on an issue of $110,000 bonds for acquiring a water system.

ST. MARIES, IDAHO.—The St. Maries Townsite and Improvement Company proposes to commence the improvement of the water works system as early in the spring as possible.

EUGENE, OR.—The City Council is discussing changes in the charter, which, among other things, will provide for issuing bonds, when properly voted, to the amount of $100,000.

ABERDEEN, WASH.—The City Council has awarded the contract for water pipe to Gardner & Co., of Tacoma, the lowest bidders. Bids for furnishing wooden pipe are to be re-advertised.

PORT TOWNSEND, WASH.—A water system is to be constructed at Fort Casey in the near future. Major Penrose has purchased land on which wells will be sunk and a pump house erected.

SPARKS, NEV.—Several of the prominent citizens of Sparks have been agitating the question of forming a water company. Water for the new system will be obtained from artesian wells.

LOS ANGELES, CAL.—The Riverdale Land and Water Company has incorporated with a capital of $300,000. The directors are, J. E. Woolwine, F. N. Doud, J. H. Griffin, *et al.*, all of Los Angeles.

BEND, OR.—The Bend Water, Light and Power Company is making arrangements to start work on the water service for Bend. E. F. Batton, H. C. Ellis and W. E. Guerin, Jr., directors.

SANTA ROSA, CAL.—At the meeting of the Trustees the Clerk was instructed to have City Engineer Norman S. Frost, of Petaluma, proceed to survey the city for a water system at once.

PASADENA, CAL.—The matter of purchasing the four water plants in the city of Pasadena by the city is approaching consumation and it is likely that an election on the question will be held.

ANDERSON, CAL.—H. H. Noble and E. V. D. Johnson, president and manager of the Northern California Power Company have secured an option on the holdings of the Anderson Water Company.

OAKLAND, CAL.—An ordinance was passed calling a bond election to be held March 11th, for the acquiring of a municipal water plant in accordance with the proposition of the Day Cities Water Company.

ROCKFORD, WASH.—The Council has passed an ordinance providing for the issuance of negotiable coupon bonds of the town of Rockford in the sum of $5398 for the construction of a water works system.

CHICO, CAL.—The Chico Land and Water Company has been ncorporated; with a capital stock of $24,000, subscribed $20,000, by J. F. Maier, Jr., Ed. Golter, Henry Kock, Ed. Maier and Joseph Giora.

LOS ANGELES, CAL.—The Christopher Land and Water Company; capital stock of $24,000, shares $2000 each, subscribed in full by L. J. Christopher, J. E. Brink, Godfry Fritz, J. A. Mathis and E. J. Stanton.

LOS ANGELES, CAL.—The Santa Monico Land and Water Company, capitalized for $1,000,000 has come into possession of approximately 30,000 acres of the Rancho San Vicente and Rancho Boca de Santa Monica.

SALT LAKE, UTAH.—A resolution will be presented to the City Council authorizing Mayor Morris and City Recorder Critchlow to advertise for bids for the purchase of the special water and sewer bonds to be issued in the sum of $1,000,000.

SEBASTOPOL, CAL.—The Clerk was instructed to communicate with Town Engineer, N. S. Frost and request him to make a survey of the town with a view to determining the most feasible plan of providing a water and sewer system.

CORVALLIS, OR.—Dr. Farra, president of the Corvallis Water Company, has made a proposition to the City Council to construct a system of water works in Corvallis to receive its supply from Rock Creek near the base of St. Mary's Peak.

SANTA ANA, CAL.—There is some dissatisfaction over the recent bond election of $100,000 for water bonds, and the parties dissatisfied may bring an election contest in an attempt to throw out the issue, claiming irregularities were practiced.

LOS ANGELES, CAL.—The Co-operative Land and Water Company has incorporated with a capital of $10,000. The directors are, J. C. Maclay, H. C. Hubbard, Josephine L. Walker, *et al.*, all of Fernando, and Richard Yarbrough, of Pasadena.

LOS ANGELES, CAL.—Lippincott & Parker, consulting engineers, of 1117 Braly Building, Los Angeles, have the specifications covering the construction of a water supply for the town of Bishop, Inyo County, Cal. Proposals received until February 10th.

BOISE, IDA.—The Council has adopted the final report of the citizen's water committee, which recommends the issuance of $503,000 bonds, $220,000 for purchase of the cold water syetem of the Artesian Hot and Cold Water Company, $70,000 for the purchase of the Perrault Canal, and $210,000 for improvements.

LONG BEACH, CAL.—The Long Beach Water Company presented an offer to the City Trustees to sell all of its real and personal property. It will sell for $400,000 and it is understood that the company is willing to accept in payment the issue of bonds which of necessity would be voted. The offer will be considered by the Council.

NORTH YAKIMA, WASH.—Robert E. Strahorn, president of the Northwest Water and Light Company states that work on the water supply will be carried on as rapidly as possible. Water will be taken from seven miles up the river and brough in a pipe to the town. The right of way is not all secured yet, but no difficulty is anticipated.

BOISE, IDAHO.—The City Council has passed an ordinance submitting to a vote of the people,on February 11th, the proposal to issue bonds amounting to $500,000 for the purchase of the cold water plant of the water company and the Walling Canal, and for appropriating $210,000 for the enlargement and maintenance of the city water system.

PORTLAND, OR.—The Suburban Home Supply, Canal and Pipe Line Company, with Lafe Pence at its head, has filled articles of incorporation in Multnomah and Clackamas counties. Water will be obtained from the Sandy and Bull Run Rivers. Mt. Tabor, Montavilla, Russelville, Stewarts, St. Johns, Woodstock and Gresham will be supplied.

HONOLULU, T. H.—Superintendent of Public Works Holloway is hoping that plans for a gravity system for the Honolulu water supply will be approved by the Legislature.. Plans have been prepared for a reservoir in Nauanu holding 100,000,000 gallons, to be 600 feet above sea level. Another smaller reservoir should be built at a still greater altitude in Kalihi Valley.

SAN FRANCISCO, CAL.—At the annual meeting of the shareholders of the Spring Valley Water Company, the old board of directors was re-elected as follows: Chas. Webb Howard, president; A. H. Payson, vice-president; F. B. Anderson, A. Borel, Homer S. King, J. M. Quay and F. J. Symmes, directors; Pelham W. Ames, secretary.

The statement of this company for 1904 shows:

Total receipts		$2,212,303.83
Disbursements—Operating expenses	$554,862.30	
Coupon and other interest	730,119.26	
Taxes	365,496.64	
Dividends (9 months)	521,889.48	
		$2,172,367.68
Gain in 1904		$39,936.15

The gain is only a little more than half of one month's dividend. The permanent improvements in enlarging and extending the works in 1904 cost $494,729.20.

NEW ELECTRIC SUPPLY COMPANIES.

OAKDALE, CAL.—G. Bernhard will open an electrical supply store.

SANTA BARBARA, CAL.—Messrs. Bradbury & Howard have opened an electric supply store at 713 State Street.

SANTA CRUZ, CAL.—John O. Mudget, the electrician, has entered into partnership with A. S. Whiting in the electrical business.

SAN FRANCISCO, CAL.—B. P. Jones has organized the Crescent Electric Company, at 276 Jessie Street, to engage in electrical contracting.

SANTA ROSA, CAL.—Mark McConnell will remove to the Carithers Building on B and Fifth Street, and will put in a full line of electrical supplies.

SAN FRANCISCO, CAL.—Willard Fletcher, Edgar Hand and Otto Mingenmayer have joined the Decker-Fagan Company, which has been incorporated with $50,000 capital.

SAN FRANCISCO, CAL.—The Bay City Electric Construction Company, D. Richardson, manager, has recently been organized, with headquarters at 1408 Devisadero Street.

BAKERSFIELD, CAL.—C. Steger and C. T. Tuttle of the C. O. D. Electric Company, of Los Angeles, have opened up a place of business at 1913 K Street. Mr. Tuttle will have charge of the business.

MISCELLANEOUS.

J. C. Sheppard will erect a water pipe works at the corner of Spadra and Wilshire Avenues, Fullerton, Cal.

J. C. Martin & Co., Pacific Coast sales agents, San Francisco, have received an order for six Williams steam operated high pressure traps. The company has added to its line the agency for the Steel Mill Packing Company in the sale of safety plastic metalic packing.

The problem of municipal ownership is the chief consideration among business men in Pasadena, Cal., and it is probable that the special election will be held in February, or a little later, to vote on an issue of $1,900,000 for the purchase of the four private plants now in operation.

S. F. Alden & Co., Rialto Building, San Francisco, Pacific Coast agents for the Davis & Farnum Manufacturing Company, of Waltham, Mass., report the sale of three steel gas holders, with a total capacity of 1,400,000 cubic feet, to the California Gas and Electric Corporation, to be used at the plant to be built to supply power for the United Railroads of San Francisco. The shipping weight of these holders will exceed 2,000,000 pounds, or about fifty carloads. The contract price approximates $125,000.

The F. W. Braun Company of Los Angeles, was awarded gold medals at the Louisiana Purchase Exposition covering practically their entire line of apparatus and appliances for assayers, metallurgists and chemists. Their exhibit was arranged in three groups, and a gold medal was secured for each group, which includes: Cary hydro-carbon burner, Marvel crude oil burner, Braun gas burner, Cary furnaces, Braun cupel machine, a complete line of ore crushing and pulverizing machines, Braun ore sampler.

The Pelton Water Wheel Company report the following among recent sales:

A 700 horsepower Pelton wheel for the hydraulic plant of the Grande Ronde Electric Company, of Oregon, who will close down the steam and water turbine plant immediately upon the completion of the new hydraulic station. The pressure under which the new wheel will operate is 877 feet.

A 450 horsepower Pelton wheel for The Nanaimo Electric Light and Heating Company, of British Columbia. This water wheel belts to a line shaft, now driven by steam engine; the latter will be used to help out the Pelton wheel at periods of low water and peak load.

The Silver Lake Mines, of Colorado, have ordered a 600 horsepower Pelton wheel to be direct coupled to a 400 horsepower Allis-Chalmers engine. The two prime movers will drive generators in the large power plant of this mining company.

A 450 horsepower Pelton wheel unit is also under course of construction for the Territorial Government of Hawaii, besides a 900 horsepower unit for La Grande Water Storage Company, of Oregon.

Pelton combination needle and deflecting nozzles are used, the deflecting portions being handled by Sturgess and Lombard Governors.